SOLOIST

HARDWARE MANUAL

P/N: EDU180 (Ver. 1.4)

Standard

with I/O Option

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DECLARATION OF CONFORMITY

Manufacturer's Name and Address

Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238-2897

Declares that the product:

Product Name: Soloist

Conforms to the following product specifications, with the exceptions listed below.

Safety: EN 61010-1:1993 Safety Requirements

and complies with EMC directive 89/336/EEC and 73/23/EEC low voltage directive.

General notes concerning the test setup.

Safety related requirements to ensure compliance:

- Soloist must be installed within an enclosure with construction compliant unlimited circuits.

Pittsburgh, PA
September, 2004

David F. Kincel
Quality Assurance Manager

Alex Weibel
Engineer Verifying Compliance

General notes concerning the test setup.

Safety related requirements to ensure compliance:

Exceptions to EN 61010-1:

- Soloist must be installed within an enclosure with construction compliant for unlimited circuits.
- End user is responsible for meeting final protective ground requirements.
- AC power disconnect is AC power cord located on front panel of Soloist. End user is responsible for determining and providing supply disconnect for system.
- End user is responsible for preventing unexpected startup.
- Connection requirements are described in the technical documentation provided with the system. End user is responsible for making proper connections and meeting any required interlock requirements for application.

- Voltages greater than 60 Volts may be present inside Soloist after a discharge time of 5 seconds.
- End user must provide protection concerning power interruption / restoration if required.
- End user must provide earth fault current protection if required.
- End user must provide protection against lightning and switching surges if required.
- Control and EStop requirements are determined and provided by the end user.
- Wire and cabling provided with the Soloist meets Aerotech's electrical and listed environmental requirements. End user must meet final requirements.

Failure to follow the described procedures could result in serious injury and/or damage to the equipment.

CHAPTER 1: INTRODUCTION

In This Section:

- Chapter Overview 1.1
- Feature Summary 1.2
- Soloist Connections 1.3
- Soloist Power 1.4
- Voltage Configurations 1.5
- Electrical Specifications 1.6
- Physical Dimensions 1.8
- Environmental Specifications 1.9

1.1 Chapter Overview

Use this chapter to become familiar with the features on your Soloist™. This chapter includes electrical, mechanical, and environmental specifications.

Standard with I/O Option

Figure 1-1 Both Versions of the Soloist

1.2 Feature Summary

Review the following summary of the standard and optional features of the Soloist.

1.2.1 Power Amplifier

- Configure for brush, brushless, and stepper motor operation
- Standard 100 VDC □320 VDC, optional 10 VDC □320 VDC bus operation
- Fully isolated power stage
- Full protection against the following failure modes:
    1. Control supply under voltage
    2. Continuous current overload
    3. Power stage bias supply under voltage
    4. Power stage output short circuit (phase to phase and phase to ground)
    5. DC bus over voltage
    6. IGBT (isolated gate bipolar transistor) device over temperature sense
- Keep alive and -AUXPWR option for emergency stop (estop) applications
- Inrush current limiting
- Internal or external shunt option

1.2.2 Dual Encoder Feedback Channels

- Primary Channel: Line driver square wave or optional analog sine wave quadrature encoder primary position and velocity feedback
- Secondary Channel: Line driver square wave auxiliary quadrature encoder input

1.2.3 Inputs and Outputs

- Four opto-isolated user outputs standard
- Six opto-isolated user inputs standard, two of which are high speed
- One differential analog input standard
- One analog output standard
- Dedicated 24 V E-stop sense input standard (5 V optional)
- Integral 24 V brake output interface
- 5 VDC, 500 mA user output power for encoder and Hall effect signals

1.2.4 -IO Option Feature Summary

- 16 additional opto-isolated user outputs
- 16 additional opto-isolated user inputs
- One additional differential analog input
- One additional analog output
- One additional Brake/Relay Output

1.3 Soloist Connections

The Soloist AC power, motor power, feedback, and communications connections are detailed in Figure 1-2.

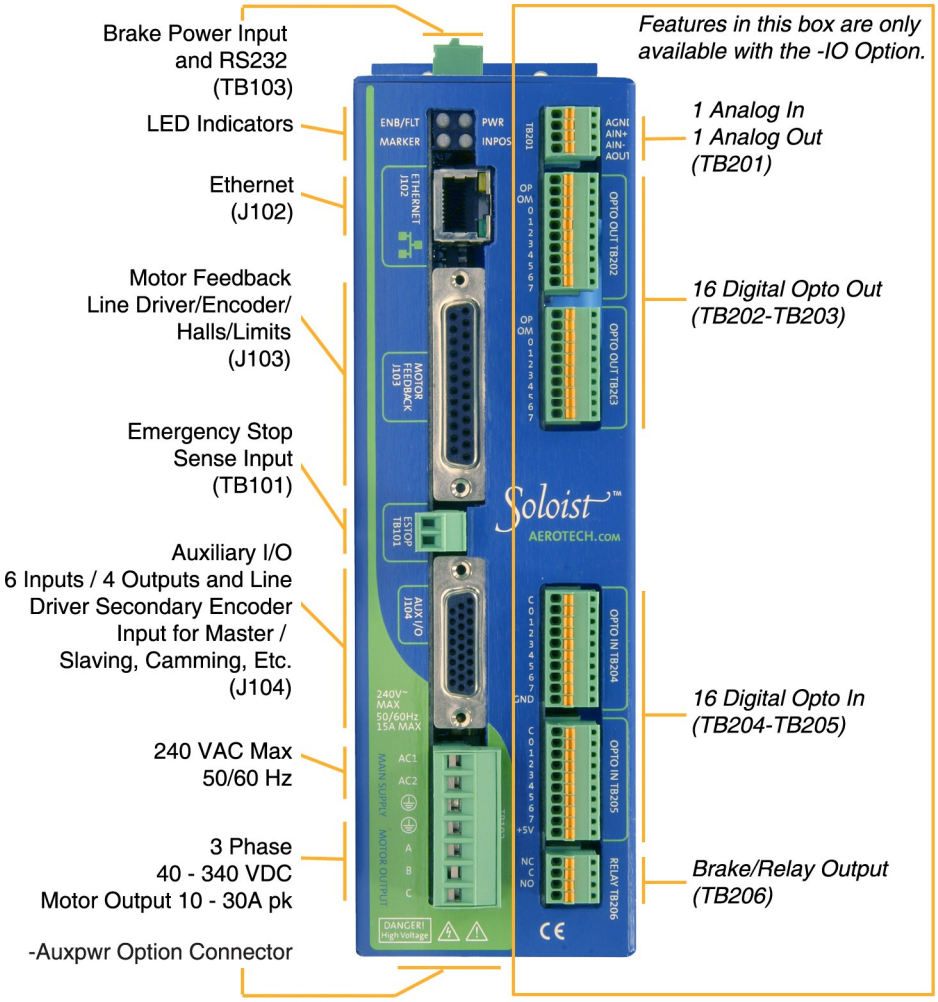


Figure 1-2 Soloist Hardware

1.4 Soloist Power Features

If you purchased the Soloist with the standard set of features, it includes the bus power supply that operates from 70-240 VAC (100 □340 VDC). The power supply provides off-line operation without the need for an isolation transformer. A soft start circuit is included to prevent high inrush currents. These features are detailed in the following diagram. Note: Figure 1-3 includes power options.

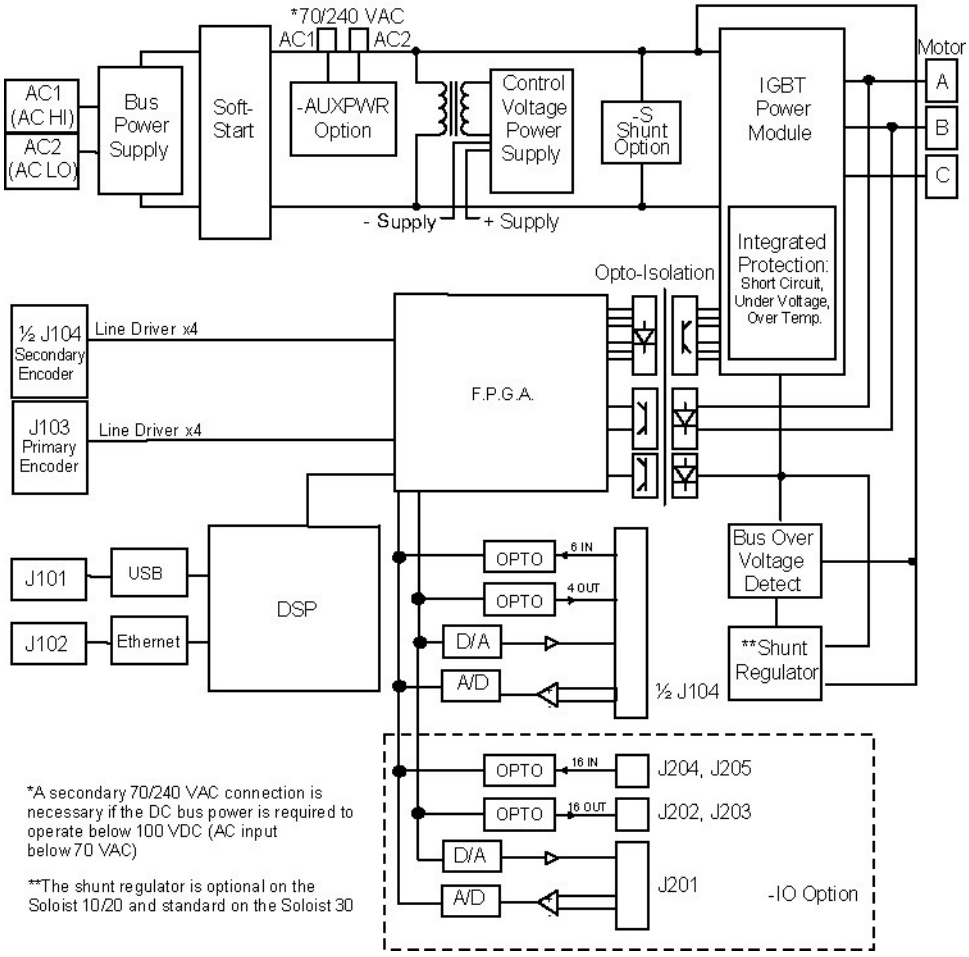


Figure 1-3 Soloist Block Diagram

1.5 Soloist Voltage Configurations

The Soloist is available in three models with continuous power, ranging from 1,100 to 2,300 watts. The available voltage configurations and power options for these models are shown in Table 1-1.

Table 1-1 Soloist Voltage Configurations

Model	Peak Output Current	Continuous Output Current (peak)
Soloist10	10A	5A
Soloist20	20A	10A
Soloist30-S	30A	15A
Options		
-S	Shunt resistor network, standard on Soloist30	
-AUXPWR	Auxiliary 115/230 VAC input to power logic circuitry; required for "keep alive" or 10-40 VDC bus operation. 10-40 VDC operation requires external transformer to generate 7-28 VAC bus power input.	
-IO	I/O option, adds 16 digital opto-inputs, 16 digital opto-outputs, 18-bit analog output and 16-bit analog input and a brake/relay output.	
-LB	Low bus voltage option for 40-100 VDC bus; doesn't support keep-alive functionality; not available with -AUXPWR option; 40-100 VDC bus operation requires external transformer to generate 28-70 VAC bus power input	
-MXU	x512 (total) software encoder resolution multiplication (primary channel only)	
-S	Shunt option (standard on Soloist30)	

1.6 Electrical Specifications

The electrical specifications for the Soloist are listed in Table 1-2.

Table 1-2 Electrical Specifications

Description		Units	Soloist10	Soloist20	Soloist30
Input Volts	Main Supply	VAC	70 - 240 VAC		
	-AUXPWR (1)				
Input Frequency	Main Supply	Hz	50-60		
Current (Max Peak)	Main Supply	Amps	42		
Max Continuous Input Power	Main Supply	Watts	1200	2400	2400
Supply Input Volts		VAC	70-240		
-AUXPWR Supply Input Frequency (1)		Hz	50-60		
-AUXPWR Supply Maximum Input Power (1)		Watts	100		
-AUXPWR Supply Input Current Maximum (1)		A (RMS)	.25		
Output Voltage (2)		VDC	15-350		
Peak Output Current (2 sec)		A (peak)	10	20	30
Continuous Output Current		A (peak)	5	10	15
Peak Power Output (3)		Watts	2300	4800	4800
Continuous Power Output (3)		Watts	1100	2300	2300
Efficiency		%	97		
Current Loop Bandwidth (4)		kHz	5 kHz max		
PWM Switching Frequency		kHz	20		
Minimum Load Inductance		mH	0.8 @ 160 VDC bus (1 mH @320 VDC)		
Maximum Optional Shunt Regulator Dissipation (-S opt.)		Watts	40		
Maximum Heat Sink Temperature		□C	75		
Heat Sink Size (typical)		Volume	25.4 x 50.8 x 6.35 (1 x 2 x .25)		
Weight (standard)		lb (kg)	3.6 (1.63)		

Notes:
1. □AUXPWR is optional
2. AC input voltage dependant. See 2.4.2.
3. Includes AC line droop
4. See the Digital Current Loop Parameters in the Soloist Help.

Table 1-2 Electrical Specifications

Feature	Description	
Modes of Operation	- Brush (torque mode) - Brushless - Stepper	
Feedback Inputs	**Hall A-Pin 10**, **Hall B-Pin 5**, **Hall C-Pin 11**: Hall effect device inputs for commutation, 0 to 5 VDC, internal pull-up, 10K input. Commutation signals used with brushless motors to provide motor rotor position information to the controller. This allows the three motor phase's currents to be varied (commutated) to rotate the motor in the desired direction at the desired speed. TTL level input. **Sine/Sine-N-Pin 17, Pin 18**, **Cosine/Cosine-N-Pin 14, Pin 15**: Encoder input 0 to 5VDC, internal pull-up, 10K input.	
Auxiliary Power Outputs	**5V-Pin 16**: On board 5V power supply. 250 mA maximum output. **5V-Pin 3**: On board 5V power supply. 500 mA maximum output (for encoder).	
Protective Features	- Output short circuit	- Peak over current
	- DC bus over voltage	- RMS over current
	- Over temperature	- Control power supply under voltage
	- Power stage bias supply under voltage	- Designed to EN61010/UL3101
Isolation	- Optical and transformer isolation between control and power stages.	
Indicator (power)	- LED indicates drive power.	
Indicator (enabled)	- LED indicates drive enabled.	

1.7 Physical Dimensions

The physical dimensions for the Soloist are shown in Figure 1-4. Separate Soloist's from each other and provide 25 mm (1 inch) of free air space.

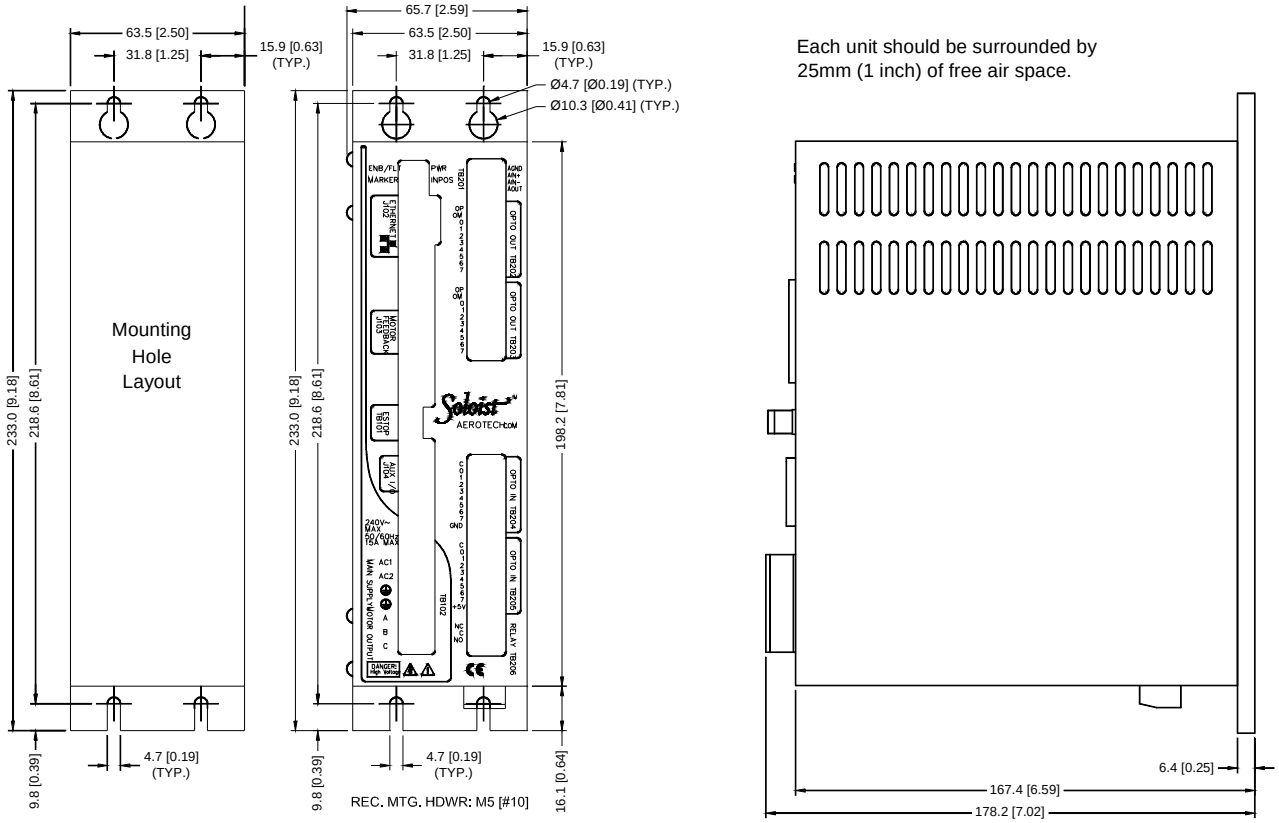


Figure 1-4 Soloist Physical Dimensions

The Soloist case temperature may exceed 75 °C in some applications.

1.8 Environmental Specifications

The environmental specifications for the Soloist are listed in the following table.

Temperature:	Ambient
Operating:	5□- 50□C (41□- 122□F)
Storage:	-20 - 70□C (-4 - 158□F)
Humidity:	Maximum relative humidity is 80% for temperatures up to 31□C, decreasing linearly to 50% relative humidity at 40□C. Non-condensing.
Altitude:	Up to 2000 meters
Pollution:	Pollution degree 2 (on-conductive pollution)
Use:	Indoor use only

□ □ □

CHAPTER 2: INSTALLATION AND CONFIGURATION

In This Section:

- Introduction 2-1
- Safety Procedures and Warnings..... 2-2
- Motor and AC Power Connections 2-3
- Wiring, Grounding, and Shielding Techniques..... 2-4
- Typical AC Wiring with the -AUXPWR Option 2-6
- Emergency Stop Sense Input (TB101)..... 2-10
- Motor Connections..... 2-12
- Communication Channel Settings 2-22
- Soloist Help Information..... 2-24

2.1 Introduction

This chapter describes hardware configurations, including switches, jumpers, connectors, and power connections used with a brush, brushless, or stepper motors. Wiring, grounding, shielding techniques, and motor phasing are also described.

2.2 Safety Procedures and Warnings

The following statements define the Warning and Danger symbols that appear in this manual. If you fail to observe these precautions, serious personal injury or damage to the equipment results.

If you use the equipment in a manner not specified by the manufacturer, the protection provided by the equipment is impaired. You must practice caution when following the given procedures. Deviation from given procedures results in damage to the equipment or machinery.

To minimize the possibility of electrical shock and bodily injury if the motor begins to spin, you must ensure that the motor is decoupled from the mechanical system.

Operator must be trained before operating equipment.

To minimize the possibility of electrical shock and bodily injury to workers when any electrical circuit is in use, you must ensure that no one is exposed to the circuitry.

To prevent bodily injury, make certain that all electrical power switches (all switches external to the amplifier) are in the off position prior to making any mechanical adjustments.

2.3 Motor and AC Power Connections

The three-phase motor terminal connections are made at connections **A, B,** and **C**. Motor Connections ØA, ØB, ØC and its Protective Ground must be made with #14 AWG wire rated @ 300 Volts. Motor frame and shield connects to ⏚ (ground).

Input voltage connection to the Soloist is made at the **AC1** and **AC2** terminals. Earth ground is connected to ⏚ (ground). Connections AC1 and AC2 and its protective ground must be made with #14 AWG wire rated @ 300 Volts.

Table 2-1 Main AC Power Input and Motor Output (TB102)

Pin	Description	Wire Gauge
AC1	240 Volt AC Maximum Input	#14 AWG
AC2	240 Volt AC Maximum Input	#14 AWG
GND	Protective Ground *(required for safety)*	#14 AWG
GND	Protective Ground to Motor *(required for safety)*	#14 AWG
ØA	Phase A Motor Output	#14 AWG
ØB	Phase B Motor Output	#14 AWG
ØC	Phase C Motor Output	#14 AWG

External fuses or circuit breakers (15 Amps maximum, time delay type) are required for the AC1 and AC2 AC inputs for protection and must be located near the Soloist. For optimum protection, use 10 Amp protection devices (15 Amp devices are required in applications requiring maximum power).

The AUXPWR input is an option, but, **if present must be powered**. For example, if the AC bus input voltage is less than 85 VAC at TB102 **AC1**, **AC2**, the optional -AUXPWR control power input must be present and powered for keep alive operation. This feature can also be used when an external emergency stop circuit is present, which removes bus power (as illustrated in Section 2.6.1 In either case, the -AUXPWR input provides keep alive or control power to the drive at all times.

The AUXPWR input is located on the side of the unit, as shown in the previous illustration. The supply connections to the AC1 and AC2 -AUXPWR inputs and the protective ground must be at least #18 AWG wire rated @ 300 V (3 Amp external fusing is required for AC2. The AC1 is fused internally at 3 Amps).

Table 2-2 -AUXPWR AC Input Option (when TB102 AC input < 85 VAC)

Pin	Description	Wire Gauge
AC1	85-240 VAC Control Power Input	#18 AWG
AC2	85-240 VAC Control Power Input	#18 AWG
GND	Protective Ground (Required for Safety)	#18 AWG

2.4 Wiring, Grounding, and Shielding Techniques

To reduce electrical noise in the Soloist, follow the motor and input power wiring techniques explained in the following section.

2.4.1 Minimizing EMI Interference

- Use shielded cable to carry the motor current and tie the shield to earth ground.
- Use a cable with sufficient insulation. This reduces the capacitive coupling between the leads that, in turn, reduces the current generated in the shield wire.
- Provide strong earth ground connections to the amplifier and the motor. Offering electrical noise a low impedance path to earth ground not only reduces radiated emissions, but also improves system performance.
- If possible, do not route motor cables near cables carrying logic signals. Use shielded cable to carry logic signals.
- Ferrite beads can be used to reduce the effects of amplifier switching.

Table 2-3 Wire Part Numbers

Wire Gauge	Aerotech PN.	Third Party PN.
#14 AWG	EIZ01027	#2643002402 Elna-Fair-Rite Products
#16 AWG	EIZ01025	#2643250402 Elna-Fair-Rite Products
#18 AWG	EIZ01001	#2673000801 Elna-Fair-Rite Products

2.4.2 AUXPWR (Auxiliary Power) Option

The -AUXPWR option provides keep alive power for the Soloist to remain operational when motor power is removed (for example, when an external emergency stop circuit is required, as illustrated in Section 2.6.1 This option also allows the Soloist to operate at bus voltages less than 120 VDC (85 VAC).

If the Soloist was purchased with the -AUXPWR option, a separate AC input has been included on the amplifier for the control power and must be powered. The internal power supply of the Soloist requires a minimum of 85 VAC input to properly operate. The following figure displays the required connection to the -AUXPWR option.

The -AUXPWR connection is made to a three terminal connector (Aerotech Part #ECK213, provided). See Section 2.5 for AC wiring options.

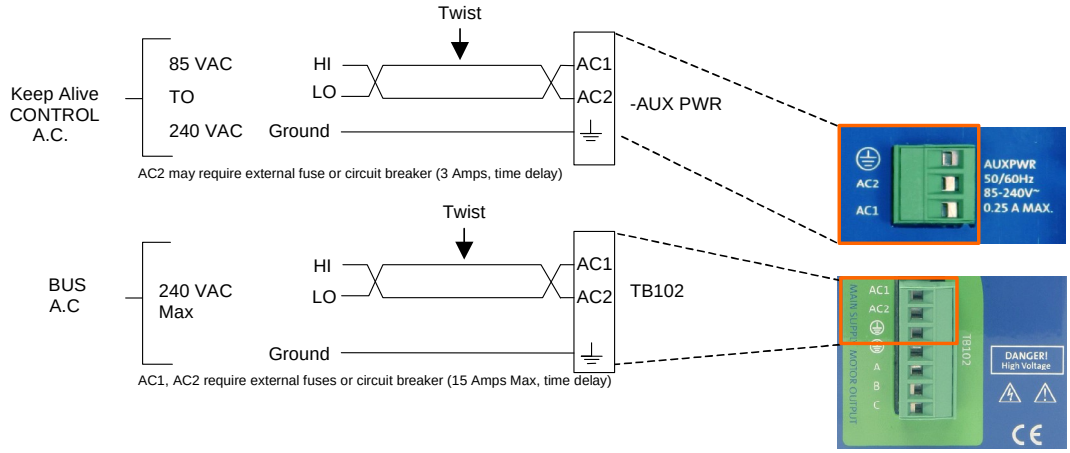


Figure 2-1 -AUXPWR Option

2.4.3 40/80 VDC Power Transformers

The TV0.3-56 power transformer is an optional accessory for the Soloist. The transformer allows the generation of 56 VAC from either a 115 VAC or 230 VAC source. When rectified by the Soloist, 56 VAC yields an 80 VDC power bus.

The TV0.3-28 power transformer is an optional accessory available for the Soloist. The transformer changes a 115 VAC or 230 VAC source to 28 VAC. When rectified by the Soloist, 28 VAC yields a 40 VDC power bus.

2.5 Typical AC Wiring with the -AUXPWR Option and an External Transformer

To generate a 40, 80 160 VDC Bus for the motor power, connect your Soloist to a 115/230 VAC source. The following three figures illustrate the six combinations available for both AC input voltages and all three DC bus voltages when the -AUXPWR option is used.

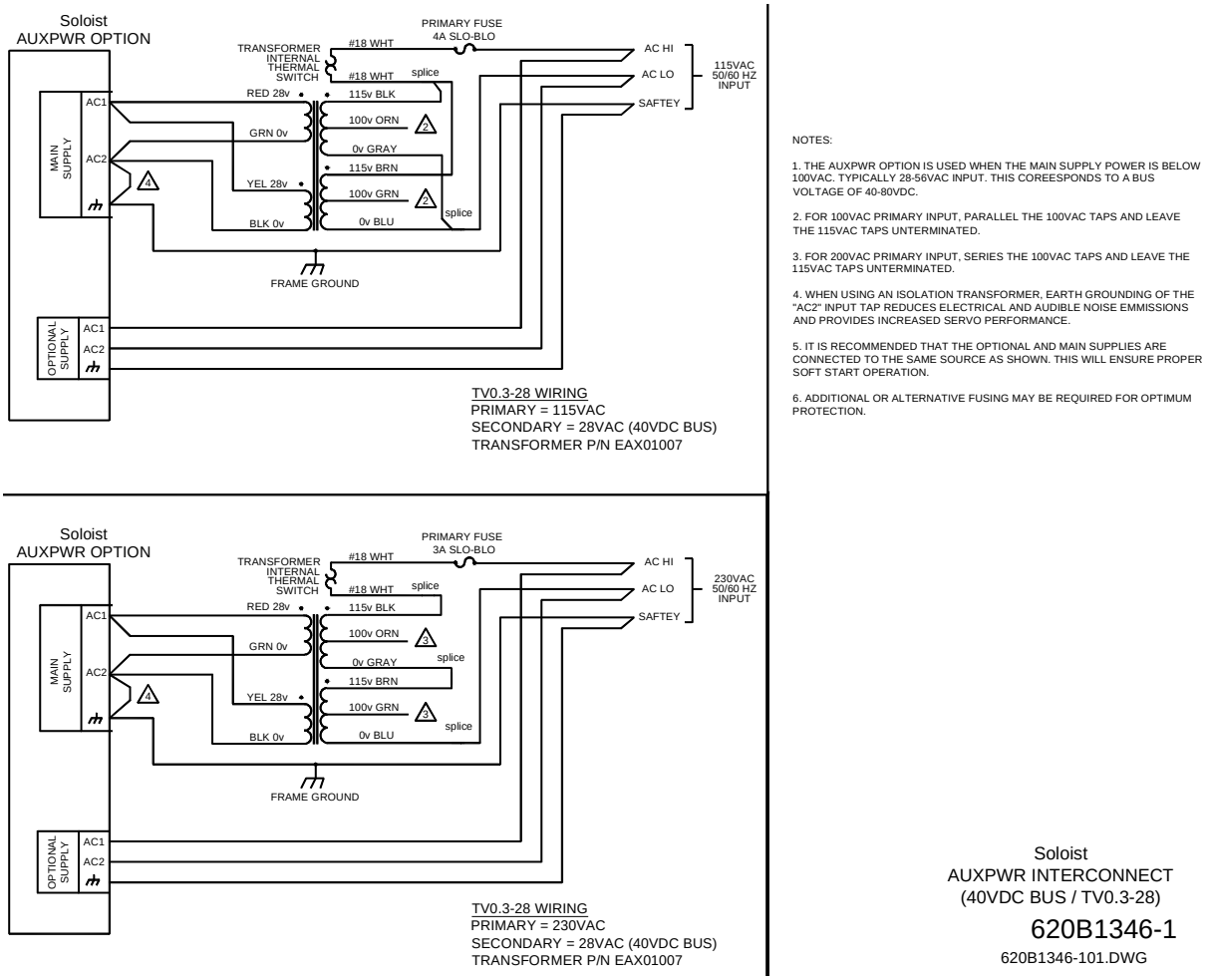


Figure 2-2 40 Volt DC Bus from 115 and 230 VAC Source

Figure 2-2 is shown only for reference. For the most recent .Dwg files, see your software CD ROM, which includes a .Dwg file viewer.

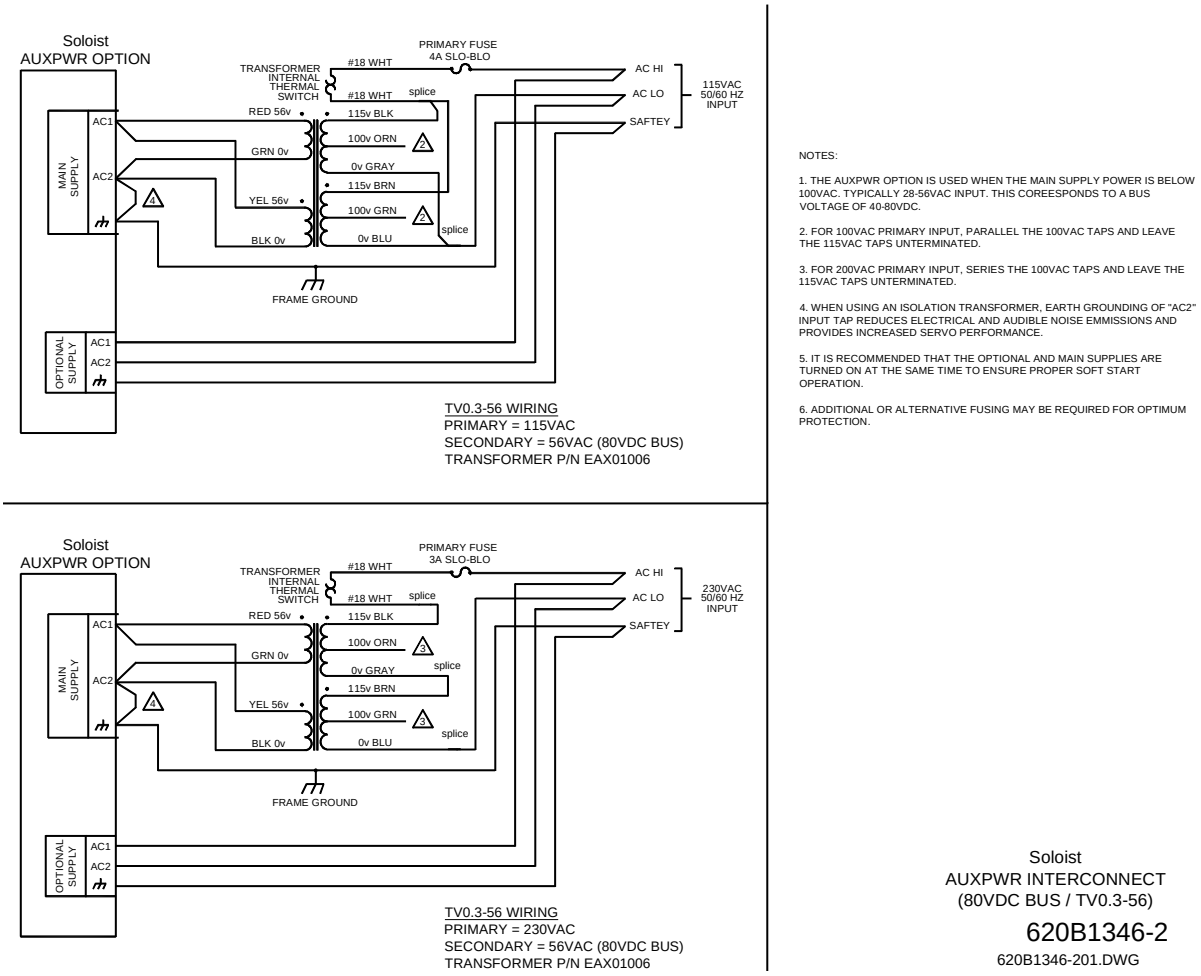


Figure 2-3 80 Volt DC Bus from 115 and 230 VAC Source

Figure 2-3 is shown only for reference. For the most recent .Dwg files, see your software CD ROM, which includes a .Dwg file viewer.

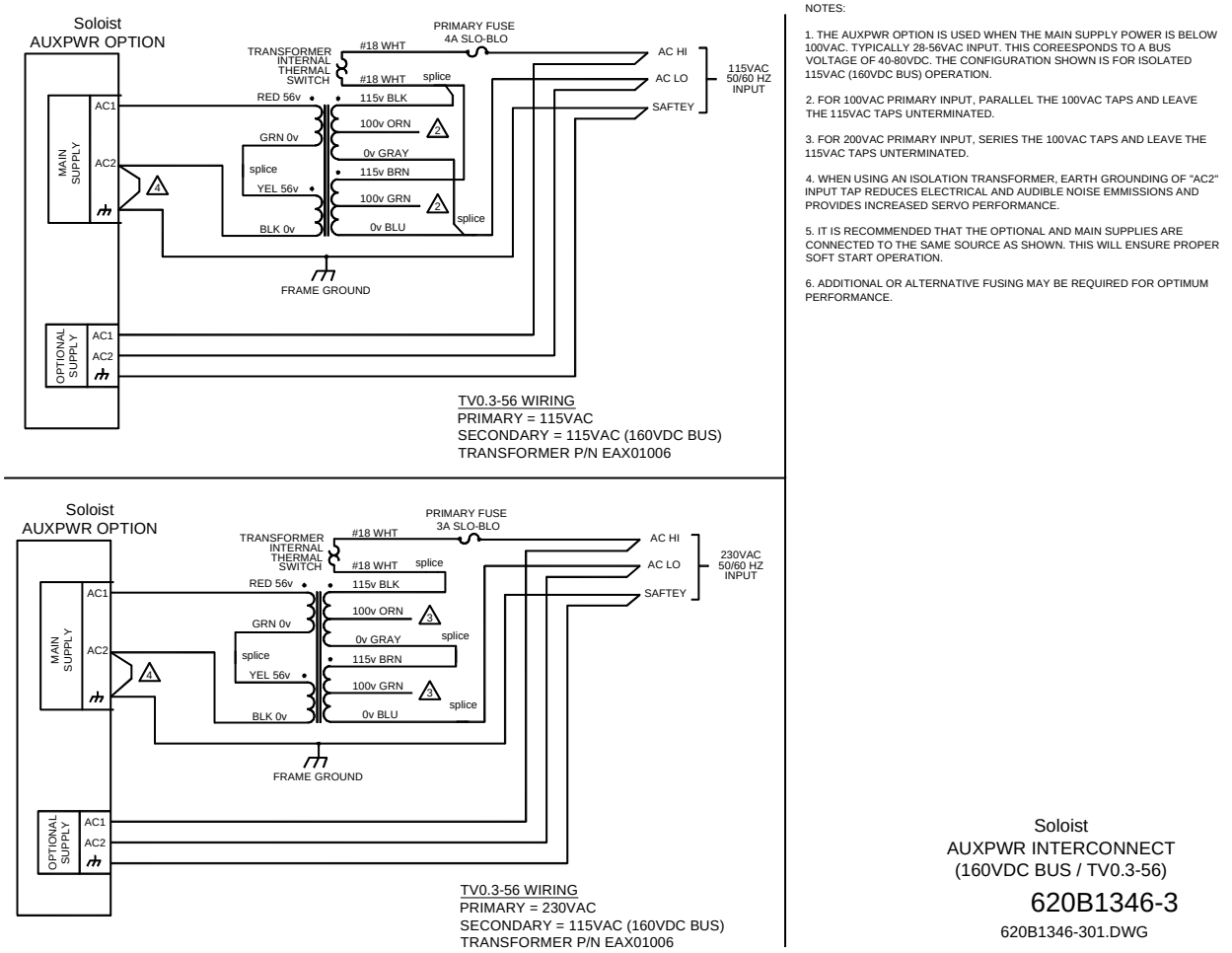
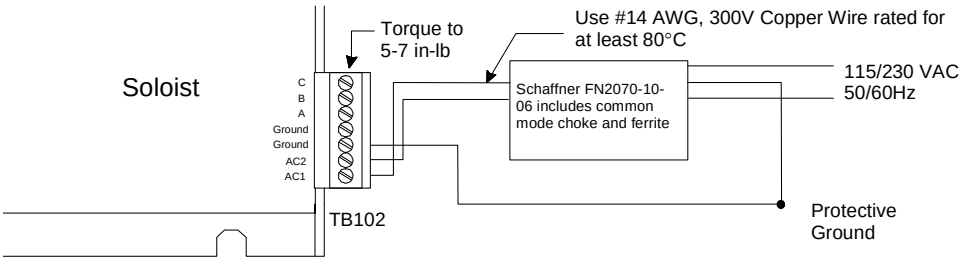


Figure 2-4 160 Volt DC Bus from 115 and 230 VAC Source

Figure 2-4 is shown only for reference. For the most recent .Dwg files, see your software CD ROM, which includes a .Dwg file viewer.

2.5.1 Minimizing 50/60 HZ Line Interference

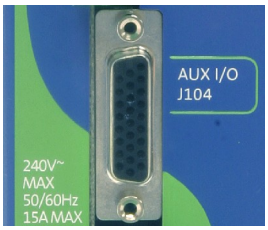
If you are operating the Soloist from an off-line power source of 115 VAC or 230 VAC, there is a potential problem of EMI (electromagnetic interference) generated from the Soloist switching power stage propagating through the bridge rectifier and out through the **AC1** and **AC2** input AC line connections. Use a line filter to minimize back-propagation of noise into the AC lines. An example of a line filter and its proper connection to the Soloist is shown in Figure 2-5.



This configuration is especially important if the Soloist is operating at DC bus voltages of 100 VDC or 340 VDC (e.g., 115 VAC to 230 VAC input power).

Figure 2-5 Back-Propagation Line Filter Connection

2.5.2 I/O and Signal Wiring Requirements

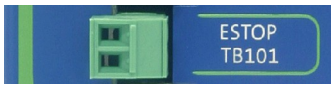


The I/O, communication, and encoder feedback connections are low power connections. Wire and connectors used for signal wiring must be rated for at least 30 V and have a current capacity of at least .25 Amp. Wires and connectors used for low voltage power connections such as +5V must have a current capacity of at least 1 Amp (encoder feedback +5V supply requires .6 Amps in some applications). In applications where there are significant wire distances, a larger wire size is required to reduce the voltage drops that occur along the wires. This increase is necessary to keep the voltage within tolerance at a remote point.

When signal wiring is in close proximity to wiring operating at voltages above 60 Volts, the insulation rating of the signal wiring must be rated for the higher voltage. Use signal wiring with a voltage rating of at least 300 Volts when it is in proximity to AC power or motor power wiring.

For additional information on connecting analog and digital I/O, see Chapter 3 and for additional information about optional I/O, see Chapter 4.

2.6 Emergency Stop Sense Input (TB101)



If you purchased the -AUXPWR option, the opto-isolated input (PS2806-1 device) activates by an external fail-safe emergency stop circuit. It is not intended to be an emergency stop circuit in itself. It is scaled for a 24 volt input voltage, or a 5 volt input by changing JP6 as shown in the following table. Using a higher input voltage requires adding an external series resistor to limit the current.

If the ESTOP bit is enabled in the FaultMaskGlobal axis parameter (see the Soloist Help), the ESTOP input must be driven to prevent the ESTOP fault condition.

For typical ESTOP wiring, see the following schematic and interface drawing.

Table 2-4 ESTOP Input Voltage Jumper

Jumper #	Setting	Description
JP6	1-2*	24 Volt DC Input
	2-3	5 Volt DC Input

* Factory default setting

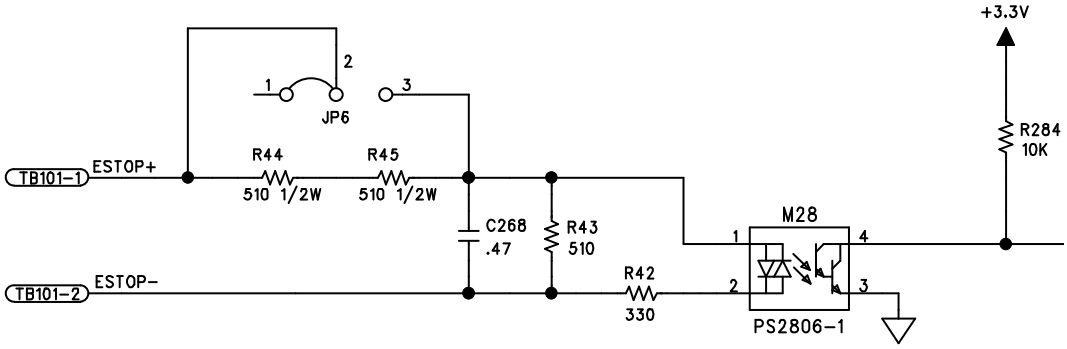


Figure 2-6 ESTOP Sense Input (TB101)

Connecting the E-Stop input to a relay or other noise producing device/circuit, requires one or more noise suppression devices, such as those in Table 2-5, or other appropriate devices.

Table 2-5. Electrical Noise Suppression Devices

Noise Suppression Device	Aerotech P.N.	Third party P.N.
RC (.1uf / 200 ohm) Network	EIC240	Electrocube RG1782-8
Varistor	EID160	Littlefuse V250LA40A

2.6.1 Typical ESTOP Interface

By connecting an emergency stop circuit to the Soloist, you disable power to the motor by removing power to the power stage of the drive while maintaining power to the control section (Figure 2-7). This is accomplished by the use of an external relay (CR1. The ESTOP sense input (TB101) notifies you of the setting of the ESTOP fault. The controllers response to the ESTOP fault is determined by the Soloist FaultMask axis parameters. For additional information, see Soloist Help.

The external relay must be sized to handle the peak inrush current of the Soloist. For additional information, see Table 1-3.

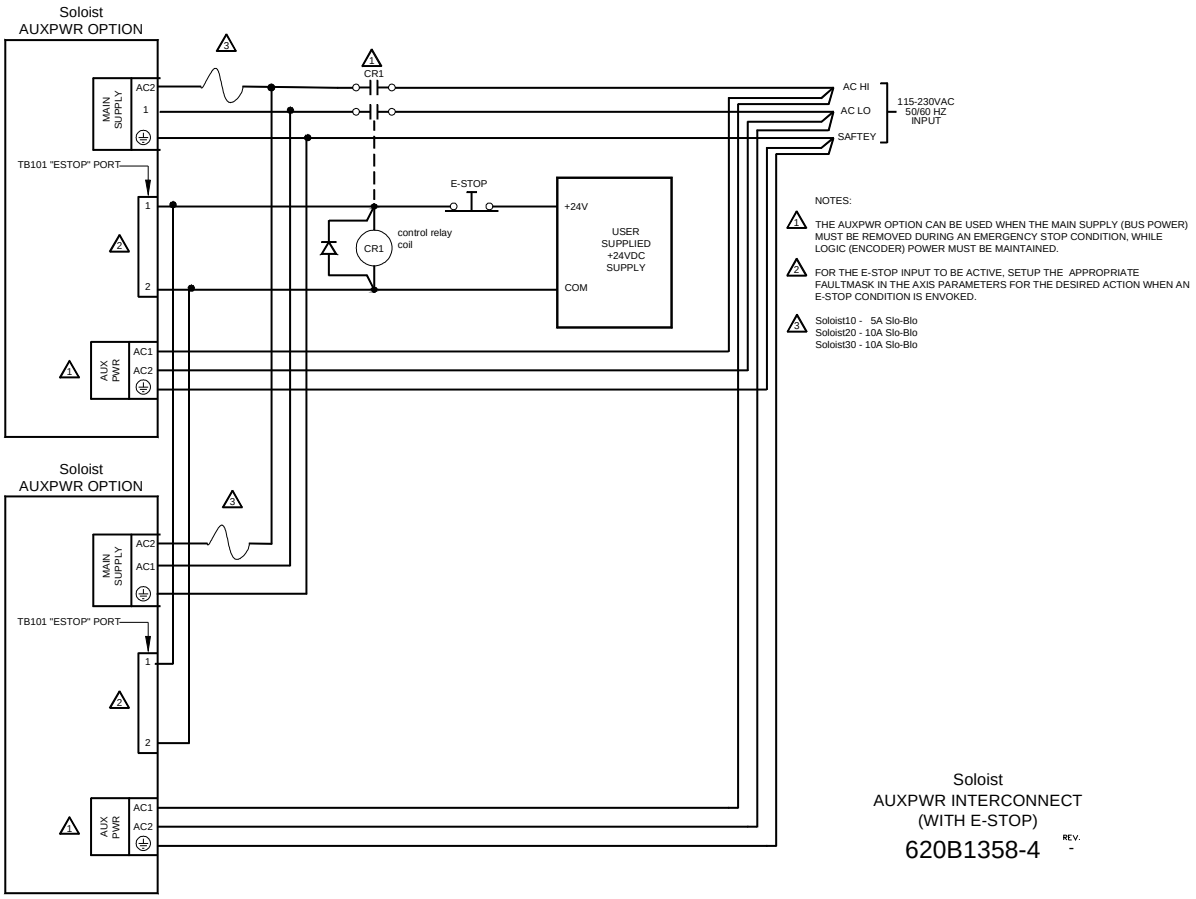


Figure 2-7 Typical Emergency Stop Circuit

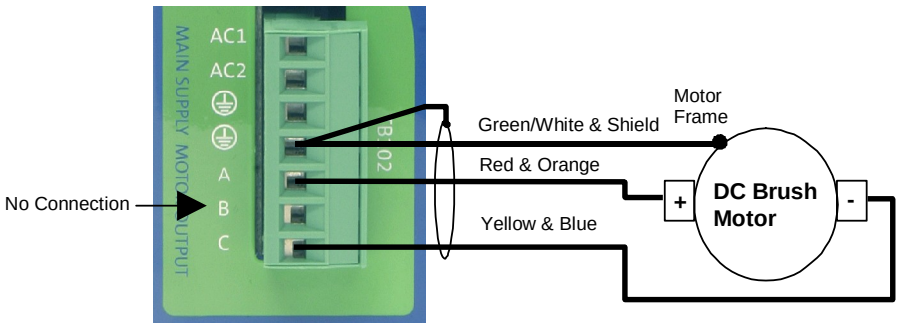
Figure 2-47 is shown only for reference. For the most recent .Dwg files, see your software CD. A viewer is included.

2.7 Motor Connections

The Soloist can be integrated into a system using three basic configurations: DC brush (torque mode), brushless, and stepper motors.

2.7.1 DC Brush Motor Connections in Torque Mode

When you connect a DC brush motor in torque mode, use the configuration shown in Figure 2-8. Note: No connection is made to the Soloist □B terminal, as shown in Figure 2-8.



Typical motor cables used are the C13802 (BADC-MSO) or BADC-MSONT.

For full cable drawings, refer to your software CD ROM.

Figure 2-8 DC Brush Motor (Torque Mode) Connections

2.7.1.1 DC Brush Motor Phasing

If you are using an Aerotech motor and cabling, no motor phasing is required.

A DC brush motor is phased correctly when a positive motion command causes clockwise (CW) motor rotation (as viewed when looking at the motor from the front mounting flange. See previous illustration.). The PosScaleFactor parameter must be set to a positive value. Motor phasing is unrelated to the direction of motion commanded from within a user task. Instead, it is determined solely by which motor lead is connected to the □A and □C motor terminals. After correctly phasing the motor, you can reverse the motor direction when commanding a positive move from a user task by negating the sign of the PosScaleFactor parameter.

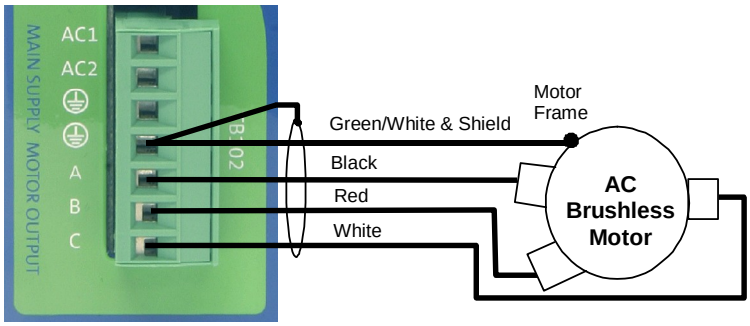
To determine which motor lead is connected to the □A and □C motor terminals, connect a voltmeter to the motor leads of an un-powered motor. Rotate the motor CW by hand. Swap the voltmeter connections to the motor until the voltmeter indicates a positive voltage. The motor lead now connected to the positive lead of the voltmeter, is the + motor lead (as indicated in the previous figure) and must be connected to the □A motor terminal. The other motor lead is connected to the □C motor terminal.

2.7.2 Brushless Motor Connections

When you connect a brushless motor that is an Aerotech motor with Aerotech cabling, no motor phasing process is required.

> If you are using an Aerotech brushless motor with the Soloist, see the system interconnection drawing in Figure 2-9 to determine the motor phase and Hall connections.

If standard Aerotech brushless motors and cabling are not used, the motor must be correctly phased, as described in the following section.

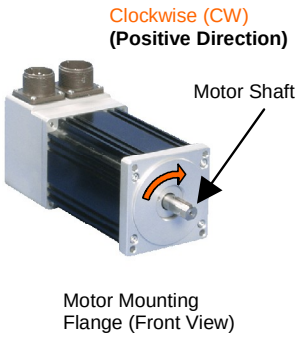


Typical motor cables used are the C13802 (BADC-MSO) or BADC-MSONT.

For full cable drawings, refer to your software CD ROM.

Figure 2-9 Brushless Motor Connections

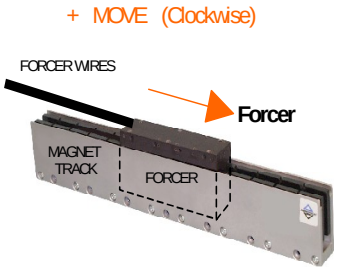
2.7.2.1 Brushless Motor Phasing



When configuring the Soloist to run a non-Aerotech brushless motor, the motor leads (A, B, and C on TB102) must be correctly connected for proper operation.

An AC brushless motor is correctly phased if a positive motion command causes CW motor rotation (as viewed when looking at the motor from the front mounting flange. See illustration.). The PosScaleFactor parameter must be set to a positive value. Motor phasing is unrelated to the direction of motion commanded from within a user task. Instead, it is determined solely by which motor lead is connected to the □A, □B, and □C motor terminals. After correctly phasing the motor, you can reverse the motor direction when commanding a positive move from a user task by negating the sign of the PosScaleFactor parameter.

Before running the Soloist\Programs\Samples\MsetDebug.Ab, configure the axis parameters. For configuration information, see Getting Started in Soloist Help.



Motor phasing is determined by two methods. In the first method, the motor open loop is actively driven under program control. The Soloist\Programs\Samples\MsetDebug.Ab can be used for this purpose. The motor phasing is correct if the program causes the motor to move in a positive direction, as shown in Figure 2-15. To correct a reversed motor rotation, swap any two motor lead connections.

The second method is a non-powered method. The motor is disconnected from the controller and connected in the test configuration (as shown in Figure 2-12); identifying 4motor leads A, B and C and Hall signals. These sequences and the generated output motor phase voltages (motor output connections □A, □B, and □C) are shown in Figure 2-12. Generate the voltages by moving the motor and forcer by hand in a positive (CW) direction.

2.7.2.2 Brushless Motor Hall Effect Feedback Connections

The Hall effect feedback signals on an AC brushless motor are correctly phased when the Hall states correspond to the states at each of the electrical angles as shown in Figure 2-12. A value of 0 for the given Hall input indicates zero voltage or logic low and a value of 1 indicates five volts or logic high. You can view these logic levels in the Soloist HMI in the Axis I/O section of the Diagnostic panel of the screen, as shown in Figure 2-11.

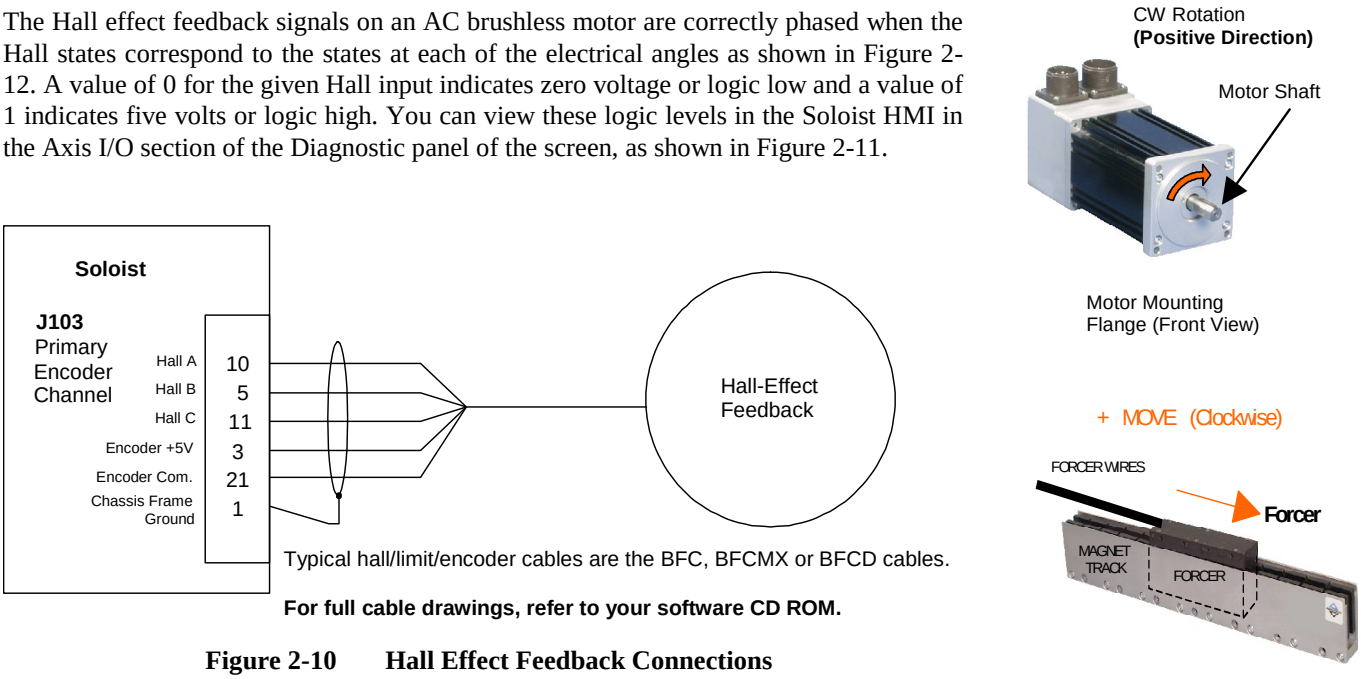


Figure 2-10 Hall Effect Feedback Connections

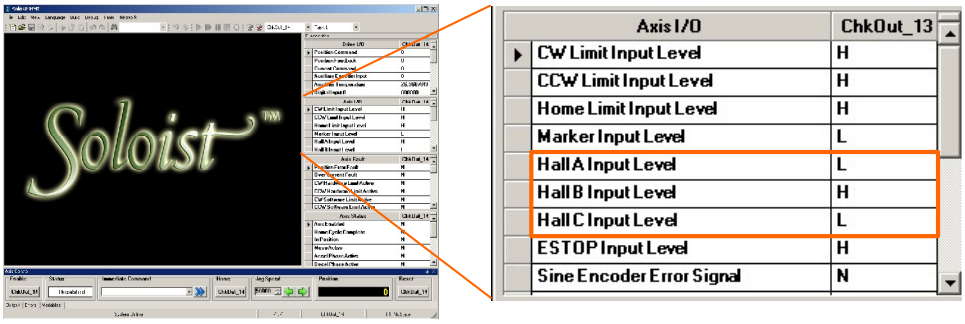
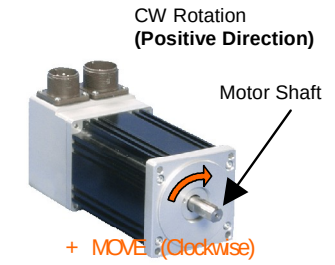
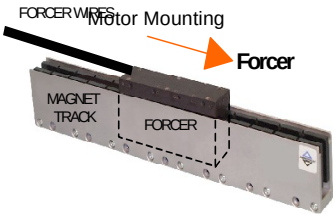


Figure 2-11 Hall Effect Feedback Inputs in the Soloist HMI Program





2.7.2.3 Hall Effect Phasing

For an AC brushless motor with an unknown Hall sequence, one of two methods can be used to determine the proper motor connections to the Soloist.

Before running the Soloist\Programs\Samples\MsetDebug.Ab, configure the axis parameters. For configuration information, see Getting Started in Soloist Help.

In the first method, the motor is actively driven under program control. The Soloist\Programs\Samples\MsetDebug.Ab can be used for this purpose. You must swap the Hall signals until they generate the sequence as defined in Figure 2-12. After the Hall sequence is correct, the program correctly determines if a commutation offset is required. The value of the CfgMotOffsetAng axis parameter that is required to correctly phase the motor is indicated.

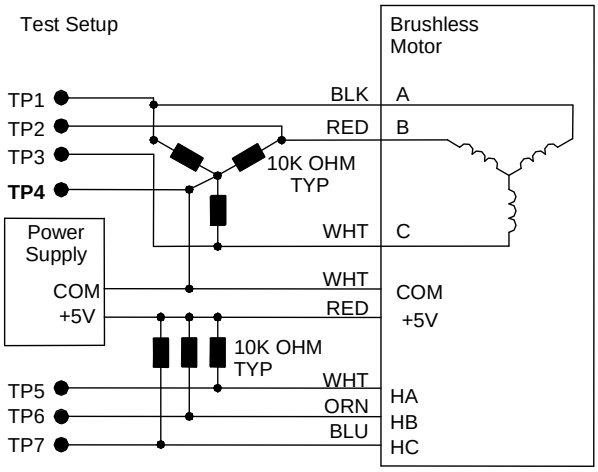
The second method is a non-powered method, using a two-channel oscilloscope and three resistors (10 K ohm, 1/2 watt) wired in a Wye configuration. The motor is disconnected from the controller and connected in the test configuration, as shown in Figure 2-12. The motor leads A, B, and C and the Hall signals are identified.

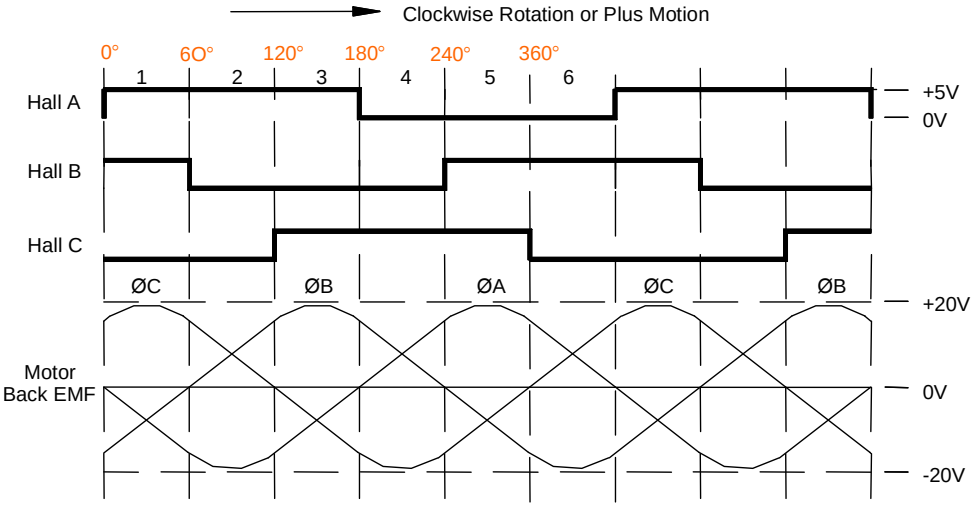
Before performing the test in Figure 2-12, you must completely disconnect the motor leads from the amplifier.

To perform the following tests, you do not need to turn the amplifier on because Figure 2-12 provides the generated output voltage data of the amplifier as determined by the input Hall sequences.

Connect the ends of the three resistors to three motor leads. Use one channel of the oscilloscope to monitor motor terminal A with a Wye neutral (that is, the point where all three resistors are connected together). Turn the shaft of the motor CW and record the generated voltage. This voltage represents the Phase A to neutral counter EMF (CEMF). With the second oscilloscope probe, determine the Hall switch that is in phase with this voltage. Similarly, Phases B and C must be aligned with the other two Hall switches. This identifies the motor and Hall lead that are in phase with each other. Any motor and Hall lead set can be designated as Phase A. The phasing between this set and the other two sets determines which set is designated as Phase B or C.

Refer to Figure 2-12 and note the generated output voltages of the amplifier applied to the Hall A, B, and C connections at connector J103. For proper operation, the CEMF generated motor phase voltages must be aligned to the amplifier's generated output voltage with the given Hall effect sequence shown in Figure 2-12.





J103	Hall Positions
10	HA
5	HB
11	HC

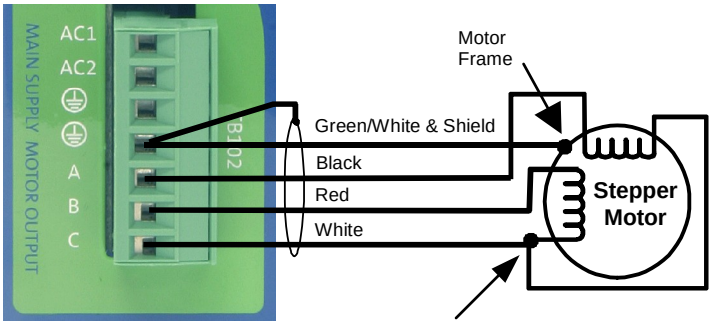
Soloist
ØA
ØB
ØC

Notes:
1. All voltage measurements are made with reference to TP4, Signal Common/Neutral.
2. Clockwise rotation is viewed looking into the front of the motor shaft.

Figure 2-12 Motor Phasing

2.7.3 Stepper Motor Connections

When you connect a stepper motor that is an Aerotech motor with Aerotech cabling, no motor phasing process is required.



Note the connection of the two motor phases

For full cable drawings, refer to your software CD ROM.

Figure 2-13 Stepper Motor Connections

2.7.3.1 Stepper Motor Phasing Process

A stepper motor is phased correctly when a positive motion command causes the motor to rotate in a CW direction, assuming a positive scaling factor, as determined by the PosScaleFactor parameter. To correct the phasing, reverse the connections to the θA and θB terminals on the Soloist. This is important because the inputs for the end of travel (EOT) limit are determined by motor rotation. After correctly phasing the motor, you can reverse the motor direction when commanding a positive move from a user task by changing the PosScaleFactor parameter to a negative value.

2.8 Encoder Feedback Connections

The same encoder feedback device is used for brush and brushless motor types. Each of the encoder channels in the Soloist accepts a differential line driver encoder. DC Brush and brushless motors may have a separate position and a velocity feedback device. Use an analog sine wave encoder with the Aerotech MXH multiplier box to multiply the encoder resolution and simultaneously convert it to a differential line driver encoder signal that can be accepted by the Soloist.

To shield signals, you must physically isolated wiring from motor, AC power, and all other power wiring.

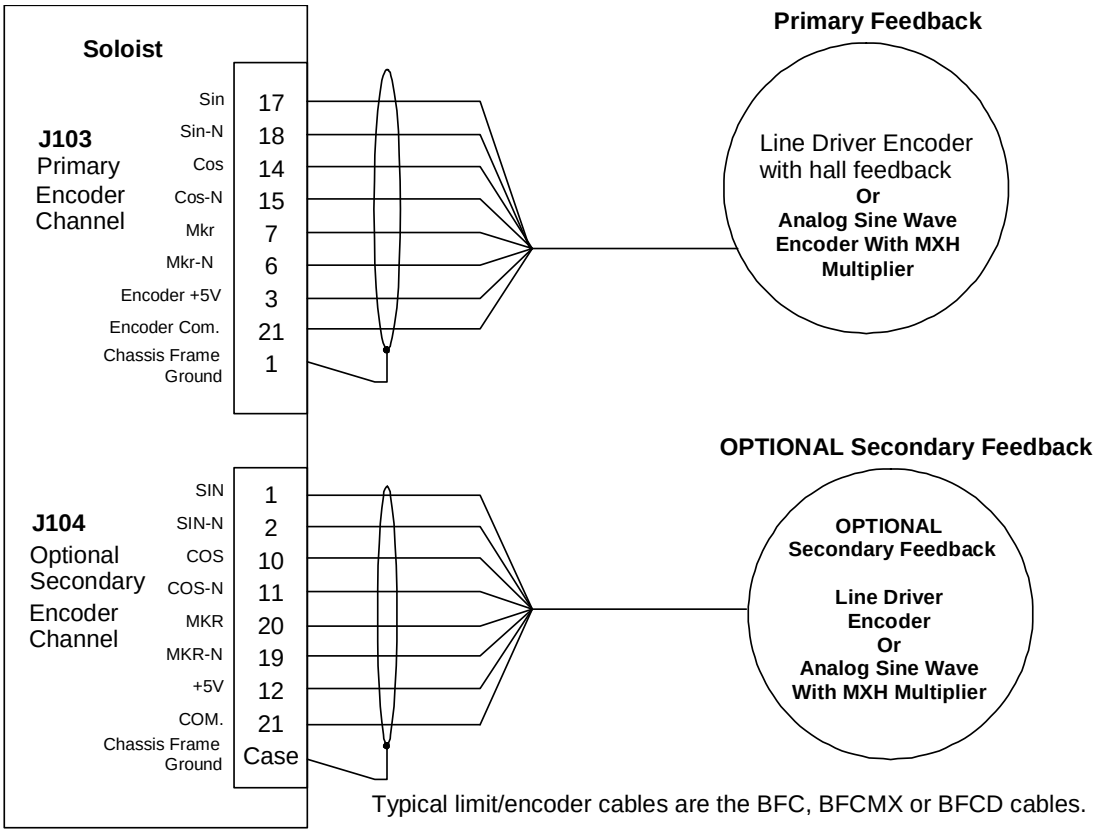
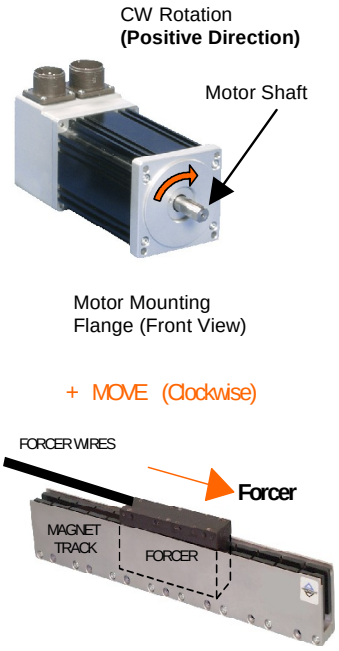


Figure 2-14 Encoder Feedback Connections

2.8.1 Encoder Phasing

Tthe required encoder phasing for CW motor rotation or positive forcer movement through the stationary magnet track is illustrated in Figure 2-15. If the motor is not visible, or cannot be manually moved by hand, it can be actively driven open loop by running the Soloist\Programs\Samples\MsetDebug.Ab program. This program moves the motor in a positive direction, allowing the position of the encoder to be monitored in the Soloist HMI, as shown in Figure 2-16. The program causes the encoder to produce a more positive position. If it counts negative, swap the connections to the controllers SIN and the SIN-N encoder inputs or the sign of the CfgFbkVelMultiplier and CfgFbkPosMultiplier parameters. However, if this axis is configured for dual loop, two feedback devices, one for position and one for velocity feedback, invert the sign of the parameter that is associated with the incorrectly phased feedback device.



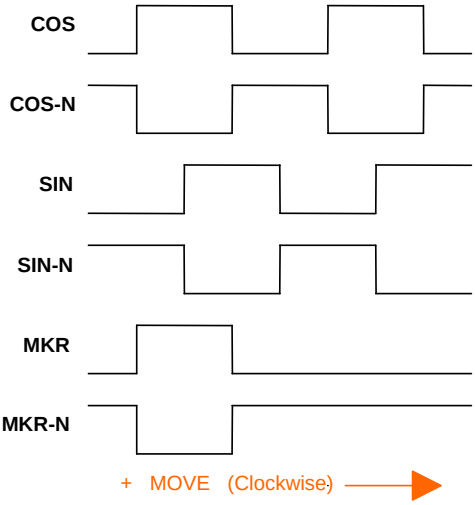


Figure 2-15 Encoder Phasing Reference Diagram

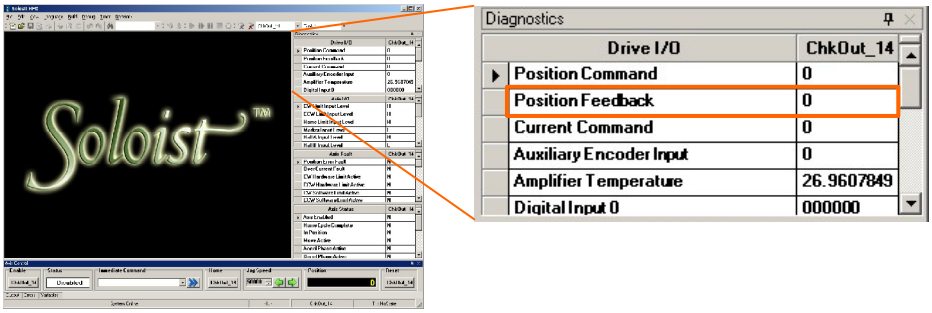
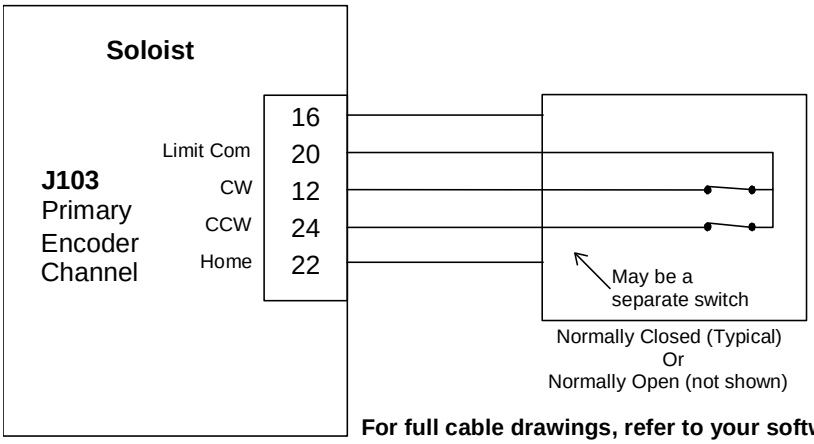


Figure 2-16 Encoder Feedback in the Soloist HMI

2.9 End of Travel Limit Connections

EOT limits define the end of physical travel of the axis and are used for homing, which defines an absolute reference for the user coordinate system. EOT limits are clockwise rotary motion or positive linear motor motion. Positive or clockwise motion is stopped by the CW EOT limit input.



For full cable drawings, refer to your software CD ROM.

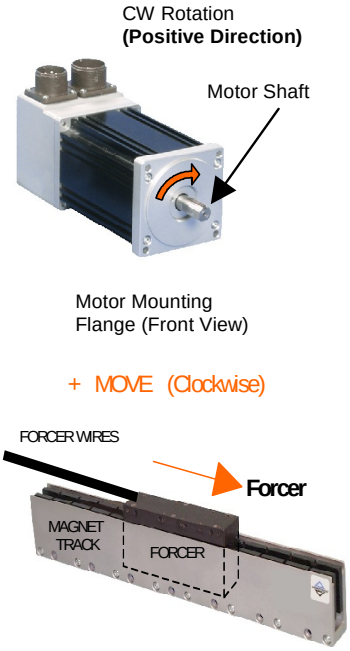


Figure 2-17 Limit Inputs in the Soloist HMI Program

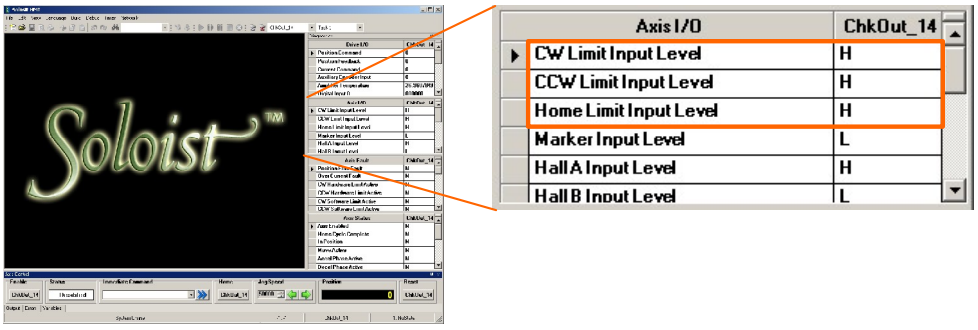
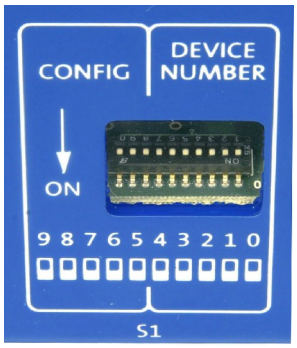


Figure 2-18 Limit Inputs in the Soloist HMI Program

2.9.1 End of Travel Limit Phasing

If the EOT limits are reversed, swap the connections to the CW and CCW inputs at the Soloist J103 connector. View the EOT limit inputs in the Soloist HMI in the Diagnostic panel's Axis I/O section, as shown in Figure 2-17.

2.10 Communication Channel Settings



You must assign a unique device number (the drive number) to each Soloist in your system, which is determined by the communication connection to the Soloist HMI or library interface. If a USB communication connection is used, the drive number is assigned with the S1 switch located on the side of the Soloist. If the Ethernet communication connection is used, the drive number is assigned by setting the IP address. For additional information, see the Soloist Help.

The Soloist network can support up to 1,024 Soloists. However, only 32 Soloists can be connected to a single PC using the USB interface because of the limitations of the S1 switch.

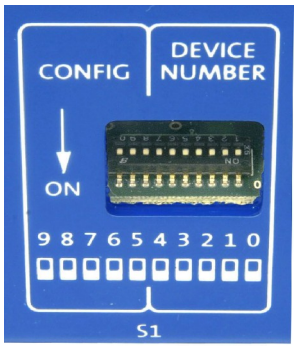
Using the Configuration Manager, assign a name to each Soloist on the network. The configuration parameters used the assigned name. If you do not specify a name, the configuration parameters the name Drive_#, where # reflects the number assigned by the communication connection.

For additional information about connecting analog and digital I/O, see Chapter 3: Technical Details.

Disconnect power to the Soloist main supply and optional -AUXPWR supply before changing the communication channel settings.

Table 2-6 Soloist Switch Settings (S1)

Soloist #	Switch Settings *					
	Switches 9 - 5 **	4	3	2	1	0
1st		ON	ON	ON	ON	ON
2nd		ON	ON	ON	ON	-
3rd		ON	ON	ON	-	ON
4th		ON	ON	ON	-	-
5th		ON	ON	-	ON	ON
6th		ON	ON	-	ON	-
7th		ON	ON	-	-	ON
8th		ON	ON	-	-	-
9th		ON	-	ON	ON	ON
10th		ON	-	ON	ON	-
11th		ON	-	ON	-	ON
12th		ON	-	ON	-	-
13th		ON	-	-	ON	ON
14th		ON	-	-	ON	-
15th		ON	-	-	-	ON
16th		ON	-	-	-	-
17th		-	ON	ON	ON	ON
18th		-	ON	ON	ON	-
19th		-	ON	ON	-	ON
20th		-	ON	ON	-	-
21st		-	ON	-	ON	ON
22nd		-	ON	-	ON	-
23rd		-	ON	-	-	ON
24th		-	ON	-	-	-
25th		-	-	ON	ON	ON
26th		-	-	ON	ON	-
27th		-	-	ON	-	ON
28th		-	-	ON	-	-
29th		-	-	-	ON	ON
30th		-	-	-	ON	-
31st		-	-	-	-	ON
32nd		-	-	-	-	-



* Off is indicated by □- □

** The shaded cells (columns 9 through 5) should be left in their factory-preset positions (normally all on).

2.11 Soloist Help Information

For additional information about the Soloist and PC configuration, hardware requirements, programming, utilities and system operation, and the Soloist HMI application, see the "Getting Started" topic in the Soloist Help.

CHAPTER 3: TECHNICAL DETAILS

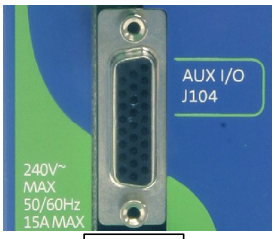
In This Section:

- Port 0 I/O and the Secondary Encoder Channel (J104)..... 3-1
- Secondary Encoder Channel (J104)..... 3-3
- Port 0 User Digital Outputs (J104) 3-5
- Port 0 User Digital Inputs (J104)..... 3-8
- User Analog Output 0 (J104)..... 3-11
- User Analog Input 0 (J104)..... 3-12
- Position Synchronized Output (PSO)..... 3-13
- Motor Feedback (J103)..... 3-15
- Brake / Relay Interface (J103, TB103)..... 3-19
- RS-232 Serial Port (TB103) 3-19
- USB Port (J101)*..... 3-20

* Planned Option, Consult Aerotech Inc. for availability

3.1. Port 0 I/O and the Secondary Encoder Channel (J104)

The J104 connector provides six user inputs and four outputs as well as a secondary line driver encoder interface. Additional I/O is provided by the -IO option board as described in Chapter 4. Three user inputs may be used as opto-isolated end of travel limit (EOT) inputs. See the following sub-sections on each type of I/O.



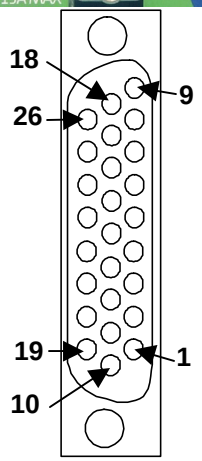
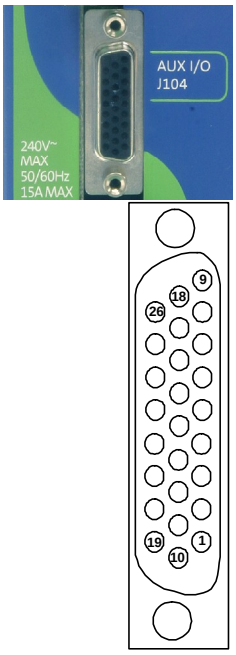


Table 3-1. Auxiliary I/O Connector Mating Connector (J104)

	Aerotech	Third Party Source
Connector	ECK01259	Kycon K86-AA-26P
Back shell	ECK00600	Cinch DA24658
Screw Locks, Qty. 2	EIZ00294	TRW D-20419-16



A re-settable fuse protects the external power provided by the Soloist to the user. Should an over-current condition occur, the fusing device would open to protect against the overload. To reset the device, remove the overload condition.

Table 3-2. Auxiliary I/O Connector Pin out (J104)

Pin #	Label	Description	In/Out/Bi.
1	Auxiliary Sine +	Secondary Encoder Channel	Input
2	Auxiliary Sine -	Secondary Encoder Channel	Input
3	In 4 + (Port 0)	Input 4 High Speed Opto. + (user interrupt)	Input
4	In 4 - (Port 0)	Input 4 High Speed Opto. - (user interrupt)	Input
5	In 5 + (Port 0)	Input 5 High Speed Opto. + (user interrupt)	Input
6	In 5 - (Port 0)	Input 5 High Speed Opto. - (user interrupt)	Input
7	Out 0 (Port 0)	Output 0 (Port 0)	Output
8	Out 1 (Port 0)	Output 1 (Port 0)	Output
9	Out 2 (Port 0)	Output 2 (Port 0)	Output
10	Auxiliary Cosine +	Secondary Encoder Channel	Input
11	Auxiliary Cosine -	Secondary Encoder Channel	Input
12	+5 Volt**	+5 Volt (500mA. max.)**	Output
13	Analog 0 In+	Analog Input 0 + (Differential)	Input
14	Analog 0 In-	Analog Input 0 - (Differential)	Input
15	Out Com	Output 0-3 opto-isolator common connection	-
16	Out 3 (Port 0)	Output 3 (Port 0)	Output
17	In 0 (Port 0)	Input 0 / CCW EOT Input (Port 0)	Input
18	In 1 (Port 0)	Input 1 / CW EOT Input (Port 0)	Input
19	Auxiliary Marker -	Secondary Encoder Channel / PSO Output - *	Bidir.
20	Auxiliary Marker +	Secondary Encoder Channel / PSO Output + *	Bidir.
21	Common	Common (+5V Supply Return)	-
22	Analog 0 Out	Analog Output 0	Output
23	Common	Common (+5V Supply Return)	-
24	In Com	Input 0-3 opto-isolator common connection	-
25	In 2 (Port 0)	Input 2 / Home EOT Input (Port 0)	Input
26	In 3 (Port 0)	Input 3 (Port 0)	Input

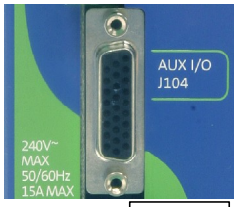
* Planned Feature, Consult Aerotech Inc, for availability

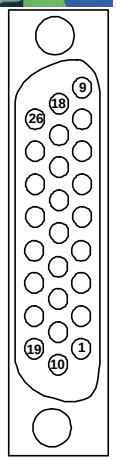
** Total user +5 V power is limited to 500 mA, by an internal re-settable fuse.

Sixteen additional digital inputs and outputs are provided by Ports 1 and 2 on the on the -IO Option board, as described in Chapter 4.

Note, that there are no input bits 6 - 7, or output bits 4 - 7 on J104, Port 0.

3.1.1. Secondary Encoder Channel (J104)





This encoder channel may be used as an input for master/slave operation (handwheel) or for dual loop systems. This encoder must be a 5-volt RS-422 line driver encoder. It allows up to an 8 MHz encoder signal (31 nanosecond minimum edge separation), producing 32 million counts per second, after times four (x4) quadrature decoding. See Figure 3-2 for typical input circuitry of the encoder signals. See section 3.1.1. for the mating connector part number. See Table 3-3 for the pin numbers on J104 related to the secondary encoder channel. See section 2.8.1. Encoder Phasing, for more information.

The Auxiliary Marker output is also the PSO output, which has a .02 micro-sec. typical propagation delay. Pull up and pull down resistors are required on this output, when used as the PSO output. The EncoderDivider axis parameter should be set to 0, to configure the Auxiliary Marker as an output.

Table 3-3. Secondary Encoder Connector Pin-out (J104)

Pin #	Label	Description	In/Out/Bi.
1	Auxiliary Sine +	Secondary Encoder Channel	Input
2	Auxiliary Sine -	Secondary Encoder Channel	Input
10	Auxiliary Cosine +	Secondary Encoder Channel	Input
11	Auxiliary Cosine -	Secondary Encoder Channel	Input
12	+5 Volt	+5 Volt (500mA. max.)*	Output
19	Auxiliary Marker -	Secondary Encoder Channel / PSO Output -	Bidir.
20	Auxiliary Marker +	Secondary Encoder Channel / PSO Output +	Bidir.
21	Common	Common (+5V Supply Return)	-
23	Common	Common (+5V Supply Return)	-

* Total user +5 V power is limited to 500 mA, by an internal re-settable fuse.

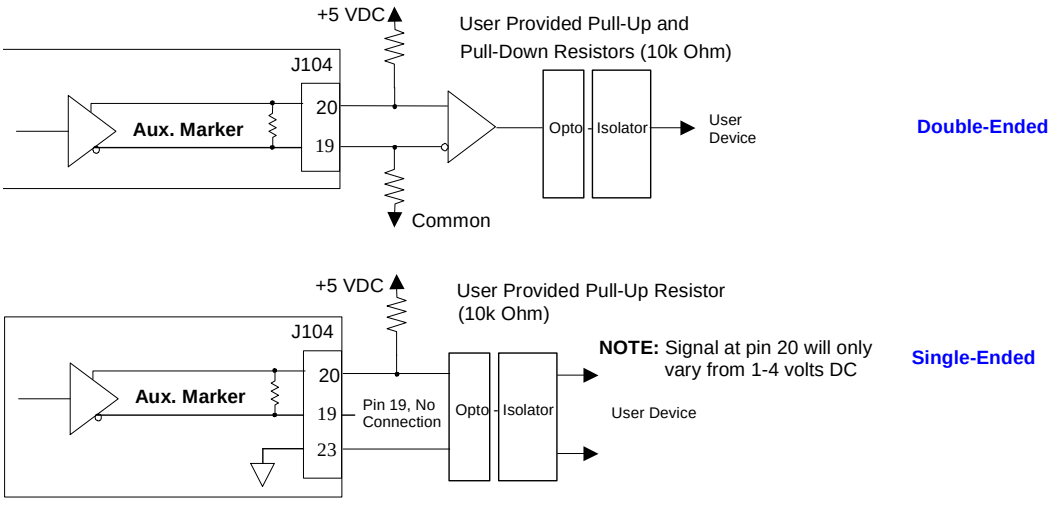


Figure 3-1. PSO Interface (J104)

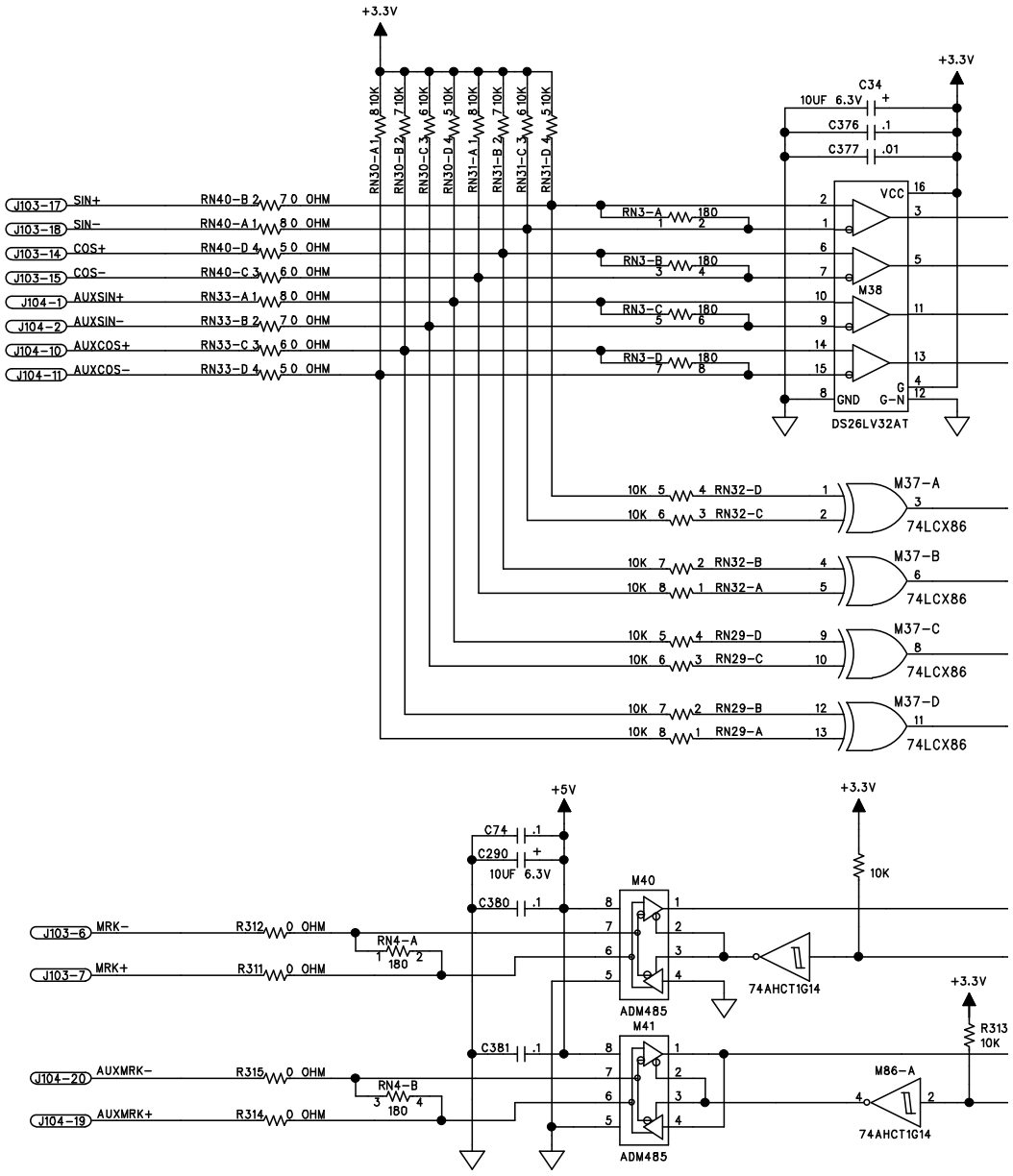
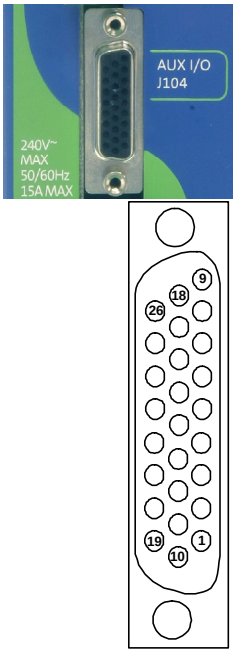


Figure 3-2. Primary / Secondary Encoder Channels (J103, J104)

3.1.2. Port 0 User Digital Outputs (J104)



The digital outputs (see Figure 3-3) are software configurable by the DriveIOConfig axis parameter as sourcing or sinking and are driven by a PS2802-4 opto-isolator. See Table 3-4 for the pin numbers and Table 3-5 for the PS2802-4 device specifications. See Figure 3-4 and Figure 3-5 for user connections to the outputs in current sourcing and current sinking modes. All outputs can be connected as sourcing, or as all sinking, as defined by the DriveIOConfig axis parameter. See section 3.1.1. for the mating connector part number. Additional I/O is provided by the -IO option as described in Chapter 4.

Sixteen additional digital inputs and outputs are provided by Ports 1 and 2 on the on the -IO Option board, as described in Chapter 4.

Table 3-4. Port 0 Digital Output Connector Pin-out (J104)

Pin #	Label	Description	In/Out/Bi.
7	Out 0	Output 0	Output
8	Out 1	Output 1	Output
9	Out 2	Output 2	Output
15	Out Com	Output 0-3 opto-isolator common connection	-
16	Out 3	Output 3	Output

Table 3-5. Opto Outputs 0-3 Specifications

Specification	Value
Maximum Output Current	80 milli-Amperes
Maximum Frequency	1 kilo-Hertz
Maximum Voltage	40 Volts DC
Maximum Power Dissipation	90 milli-Watts per (output) channel
Typical Rise Time	250 micro-Seconds
Saturation Voltage	.85 Volt @ 80mAmps, .7 Volt @ 1mAmps

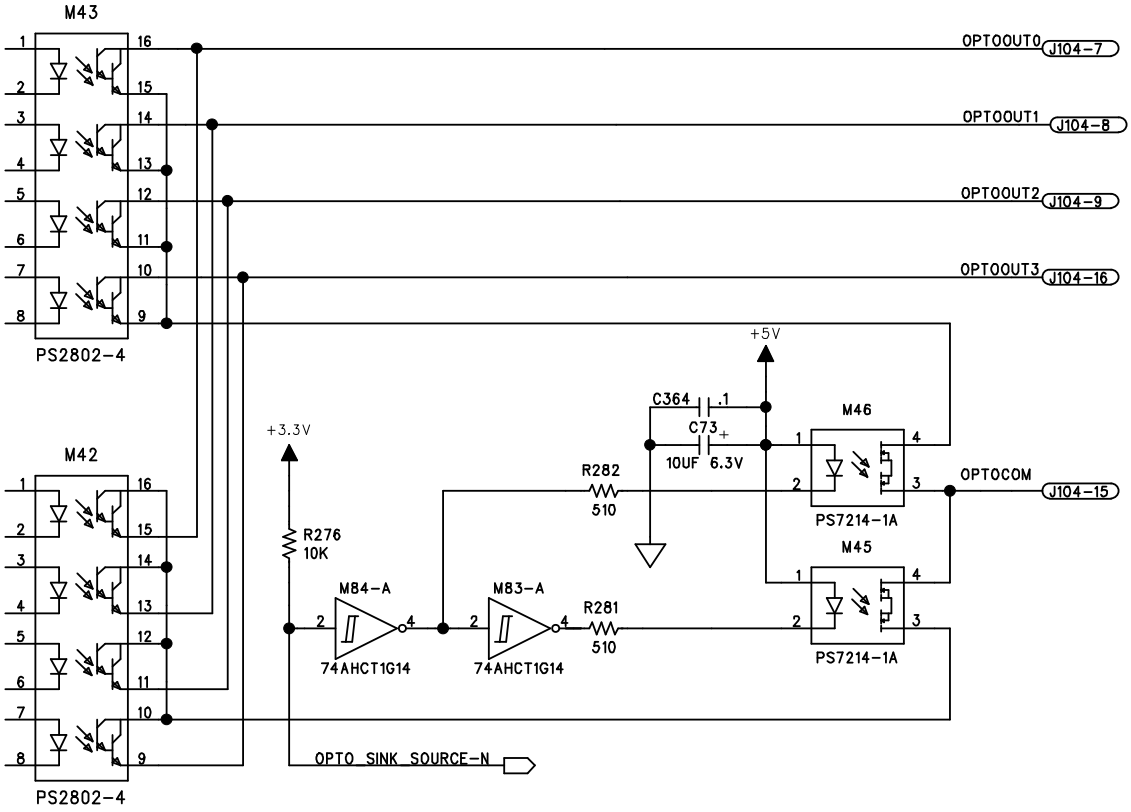


Figure 3-3. User Outputs (J104)

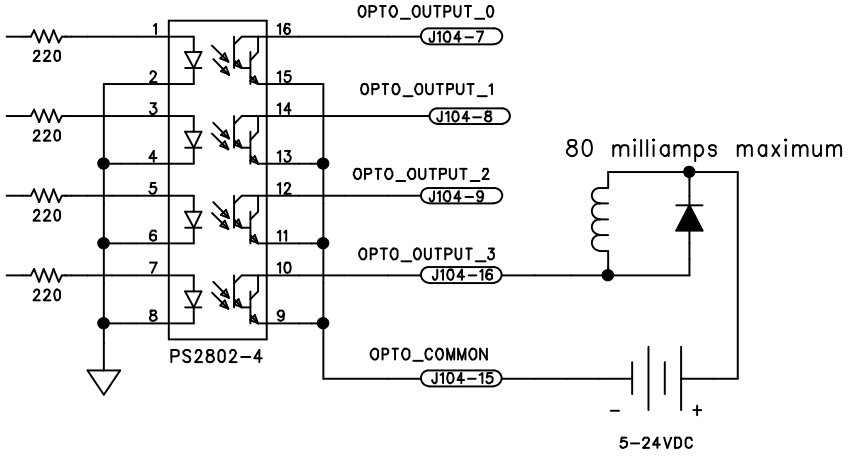


Figure 3-4. Outputs Connected as Current Sinking

Be sure to set the DriveIOConfig axis parameter, to configure the outputs as current sinking or current sourcing!

All outputs on a port (0, 1 or 2), must be connected as all sourcing, or all sinking outputs.

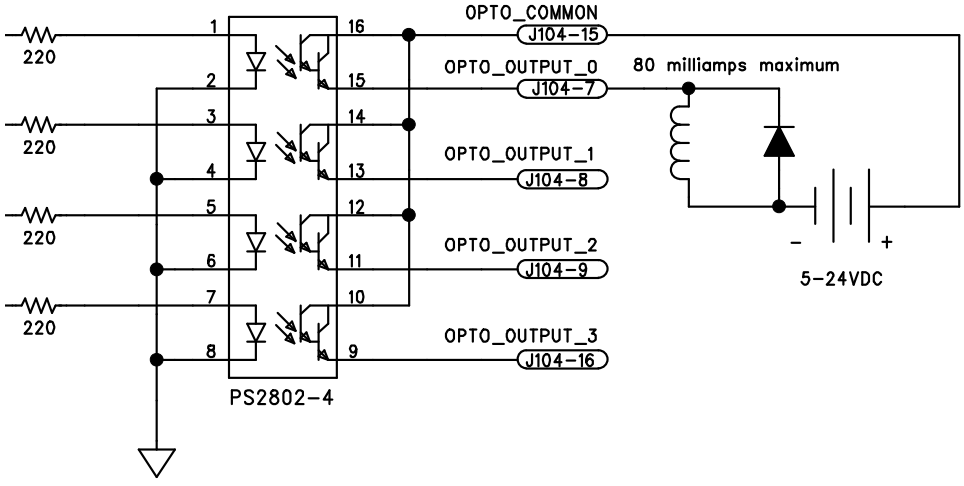
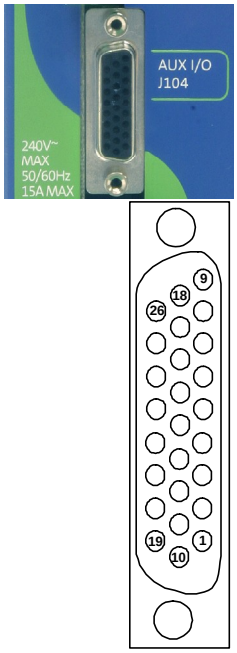


Figure 3-5. Outputs Connected as Current Sourcing

3.1.3. Port 0 User Digital Inputs (J104)



The high-speed inputs 12 and 13 (Figure 3-8), are scaled for a 5 volt input voltage. Using a higher input voltage requires adding external series resistors to limit the current to 20 milliamps. For example, for 24 volt operation add a 1,000 ohm, □ watt resistor in series with each opto input pin. See Table 3-6 for the pin numbers. The high-speed inputs (inputs 4 and 5) are isolated by an HCPL-0630 opto-isolator and have a typical delay of 50 nanoseconds. The lower speed inputs, numbered 0-3 are isolated by a PS2806L-4 opto-isolator. Inputs 0-2 may also be used as Home and CW, CCW end of travel limit inputs, respectively, by setting bit 22 of the DriveIOConfig axis parameter. Figure 3-6 illustrates interfacing an active device or a switch to the inputs. In either case, an external power supply is required, to maintain the isolation provided by the opto-couplers. See Section 3.1.1. for the mating connector part number. Additional I/O is provided by the -IO option as described in Chapter 4.

Sixteen additional digital inputs and outputs are provided by Ports 1 and 2 on the on the -IO Option board, as described in Chapter 4.

Table 3-6. Port 0 Digital Input Connector Pin out (J104)

Pin #	Label	Description	In/Out/Bi.
3	In 4 +	Input 4 High Speed Opto. + (user interrupt)	Input
4	In 4 -	Input 4 High Speed Opto. - (user interrupt)	Input
5	In 5 +	Input 5 High Speed Opto. + (user interrupt)	Input
6	In 5 -	Input 5 High Speed Opto. - (user interrupt)	Input
17	In 0	Input 0 / CCW EOT Input	Input
18	In 1	Input 1 / CW EOT Input	Input
24	In Com	Input 0-3 opto-isolator common connection	-
25	In 2	Input 2 / Home EOT Input	Input
26	In 3	Input 3	Input

Note: Port 0 digital Inputs 0 - 3, must all be used in either current sourcing or current sinking mode. No combination of these two modes is allowed.

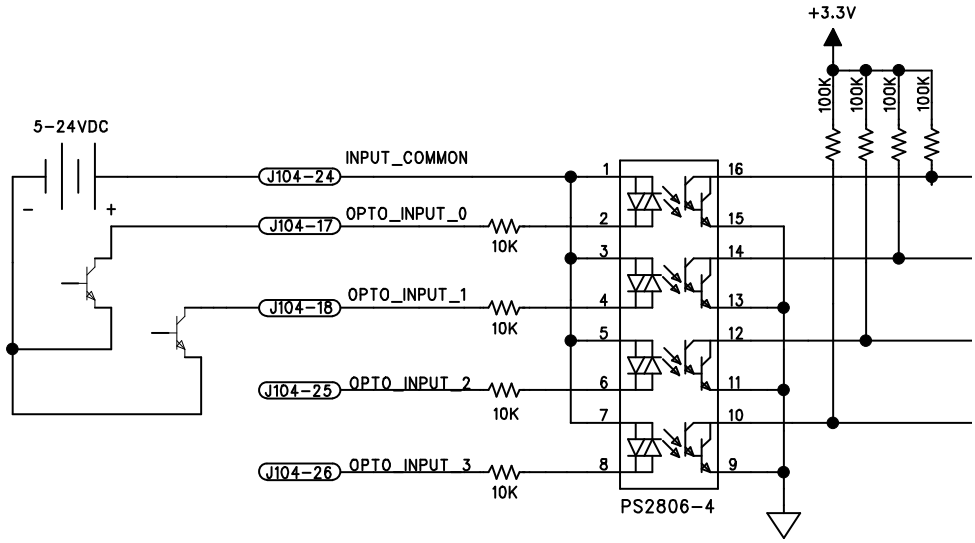


Figure 3-6. Connecting Current Sinking Inputs

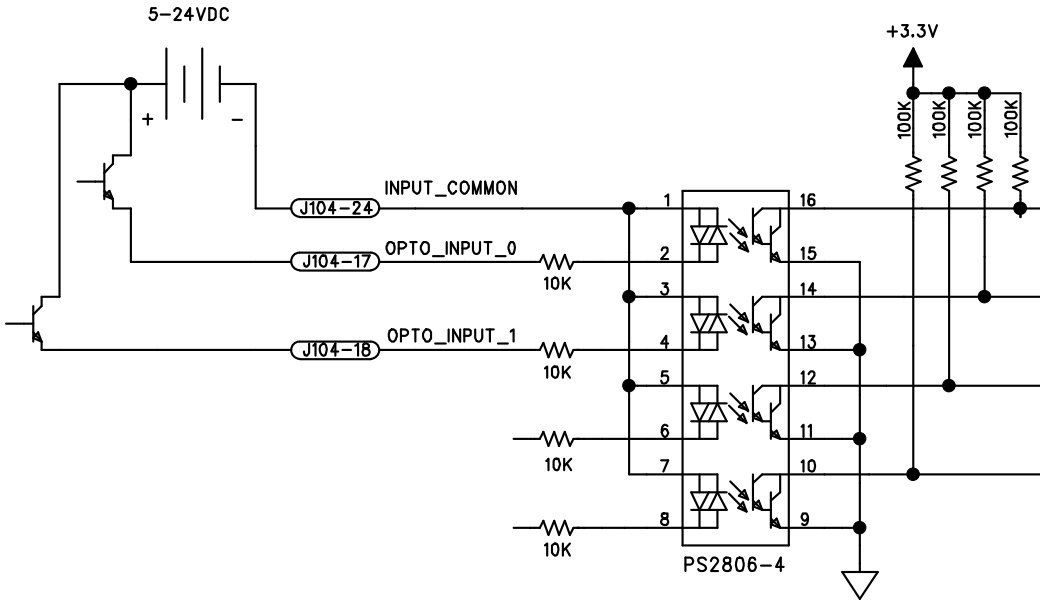


Figure 3-7. Connecting Current Sourcing Inputs

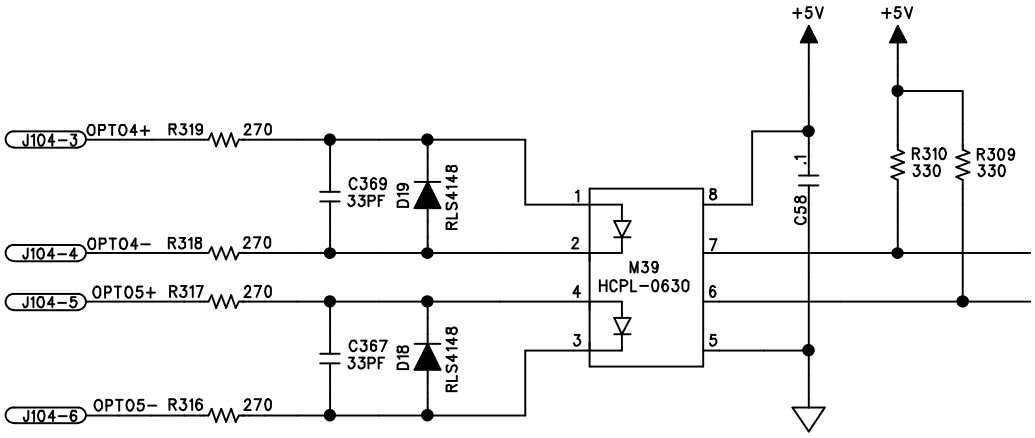
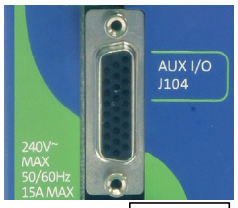


Figure 3-8. Low Speed and High Speed User Inputs (J104)

3.1.4. User Analog Output 0 (J104)



Analog output 0 is driven by a 16-bit DAC8531 digital to analog converter and buffered by TL082 op-amps, producing a single-ended output voltage in the range of +/- 10 volts. This produces a resolution of 305 uVolts per bit of the D/A. The output current is limited to less than 50 mA. See Table 3-7 for the pin numbers. Note that the analog output is referenced to J104-21 or 23. See Section 3.1.1. for the mating connector part number. A second analog output is provided on the -IO option board.

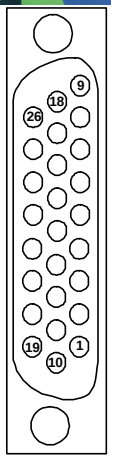


Table 3-7. Analog Output Connector Pin-outs (J104)

Pin #	Label	Description	In/Out/Bi.
22	Analog 0 Out	Analog Output 0	Output
21	Common	Common	N.A.
23	Common	Common	N.A.

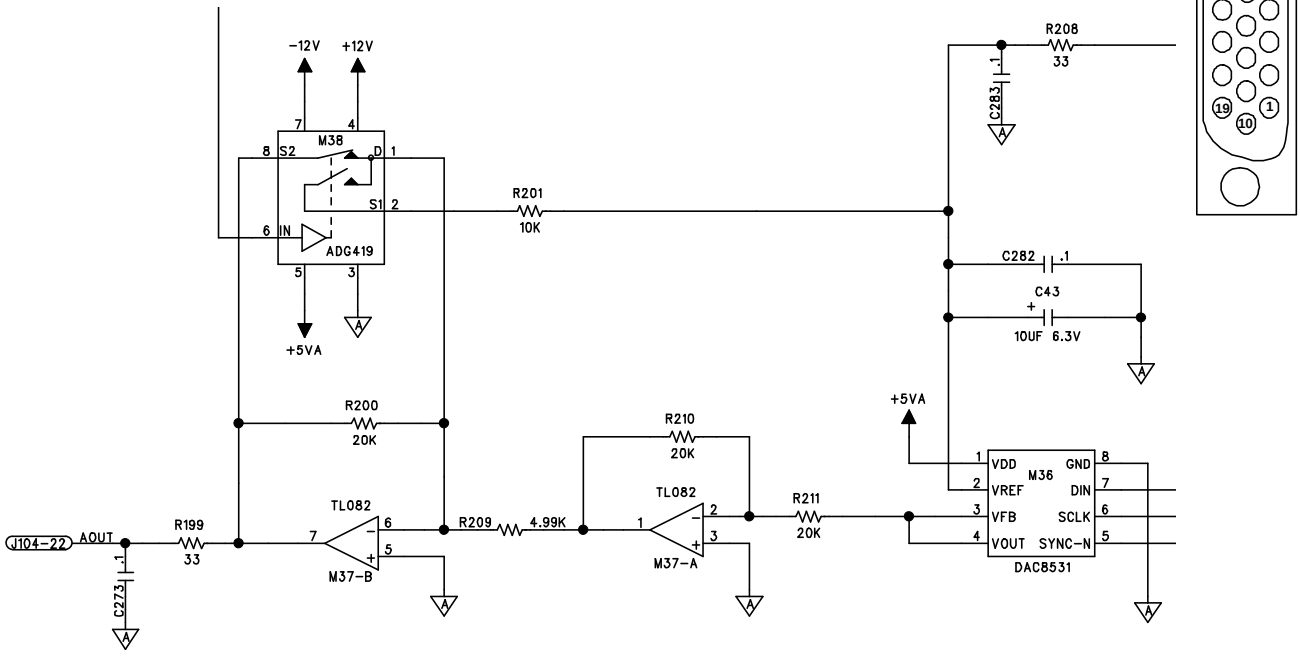
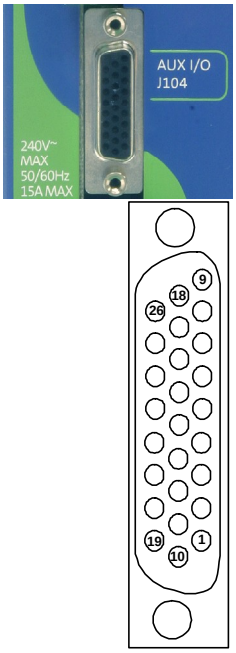


Figure 3-9. Analog Output 0 (J104)

3.1.5. User Analog Input 0 (J104)



Analog input 0 is differential, buffered by a TL082 op-amp and converted to digital by 12-bit ADS7816 analog to digital converter allowing an input voltage in the range of +/- 10 volts. Signals outside this range may damage the input. The 12-bit ADC produces a resolution of 4.88 mVolts per bit of the A/D. Refer to Figure 3-10. See Table 3-8 for the pin numbers. To interface to a single-ended (non-differential) voltage, ground the negative (-) input and connect your signal to the positive (+) input. See Section 3.1.1. for the mating connector part number. A second analog input is provided on the -IO option board.

Table 3-8. Optional Analog Input Connector Pin-outs (J104)

Pin #	Label	Description	In/Out/Bi.
13	Analog0 In +	Positive Analog Input 0	Input
14	Analog0 In -	Negative Analog Input 0	Input
21	Common	Common	N.A.
23	Common	Common	N.A.

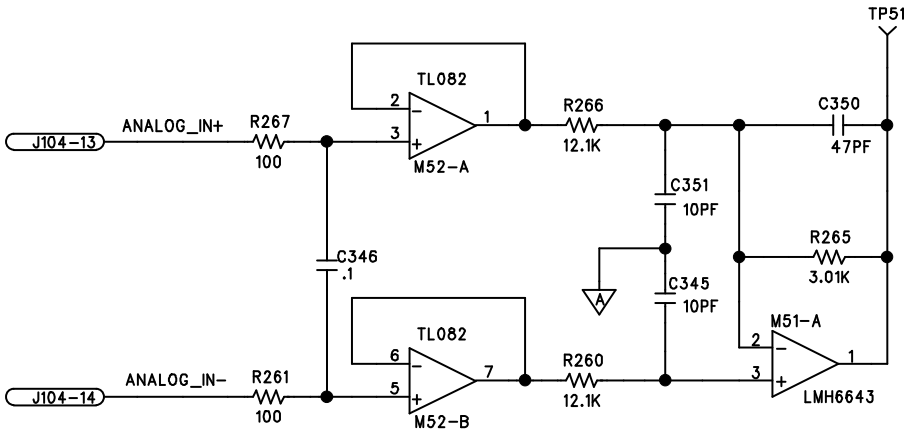
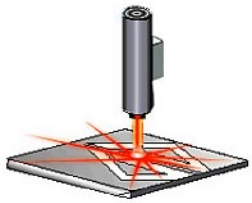


Figure 3-10. Analog Input 0 (J104)

3.2. Position Synchronized Output (PSO)



The Soloist includes a Position Synchronized Output (PSO) option. This feature may be programmed to generate an output synchronized to the axis position, based upon a user-defined trigger condition. The Soloist provides only single-axis tracking of one of the two encoder input channel. Encoder signals may come from the primary or secondary encoder channels. These input channels allow a 40 Mhz. input data rate (50 nsec. minimum edge separation), however, the maximum PSO tracking rate is 25 Mhz. A software command may also be used to generate an output pulse. The synchronized output pulse is solely generated within sophisticated and versatile high-speed hardware, providing excellent firing accuracy, and allowing minimal delays between the trigger condition and the output. PSO latency is 210 nanoseconds, including the propagation delay of the output device. The output pulse is a differential RS-422 signal available on the J104 connector (see Section 3.1.1. for more information). Additionally, the PSO options provide Data Capture capabilities, shown in Figure 3-11 and Figure 3-12. For programming information, refer to the Soloist HMI Help.

Refer to Figure 3-11 and Figure 3-12 for a block diagram of the PSO capabilities.

Table 3-9. PSO Output Source

PSO Output Type	Maximum Frequency	Requires User Isolation
RS-422 Marker output on the Secondary Encoder - J104	10 MHz	Yes

The PSO hardware operates in machine counts. The PSO hardware typically generates a trigger from a position change. The comparison of the desired trigger position to feedback position occurs at a 25 Mhz. rate.

The output pulse is also user programmable, and is generated by dedicated hardware logic. It may be a single, or multiple pulse per trigger event. A trigger event may generate a single pulse or a programmable number of pulses.

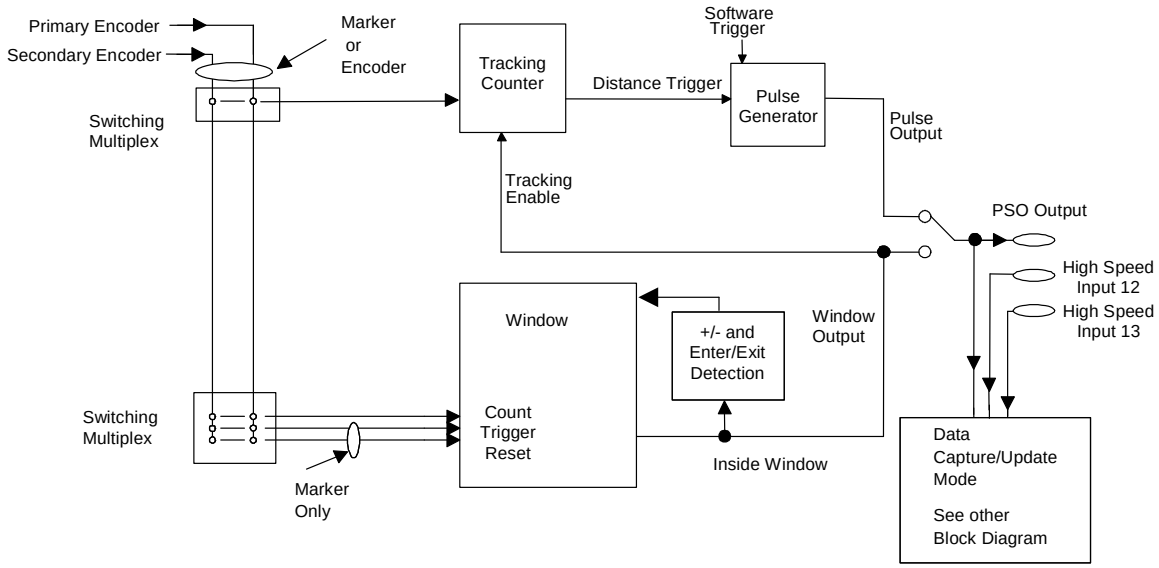
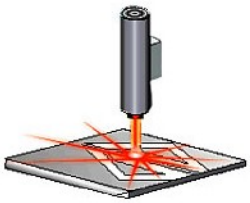


Figure 3-11. PSO Block Diagram



The window modes allow firing to occur, or be enabled, based upon axes being within a user-defined window. The +/- and Enter/Exit Detection block within the block diagram is used to prevent false triggering due to one bit dither on an axis, etc. Window modes may not be pre-scaled as indicated in the block diagram.

Data Capture mode allows the encoder position to be captured at the PSO trigger locations. Data Update mode allows analog or digital outputs to be set by the same trigger. The capture and update modes are defined in Figure 3-12. For a full description of these modes, refer to the Soloist HMI help.

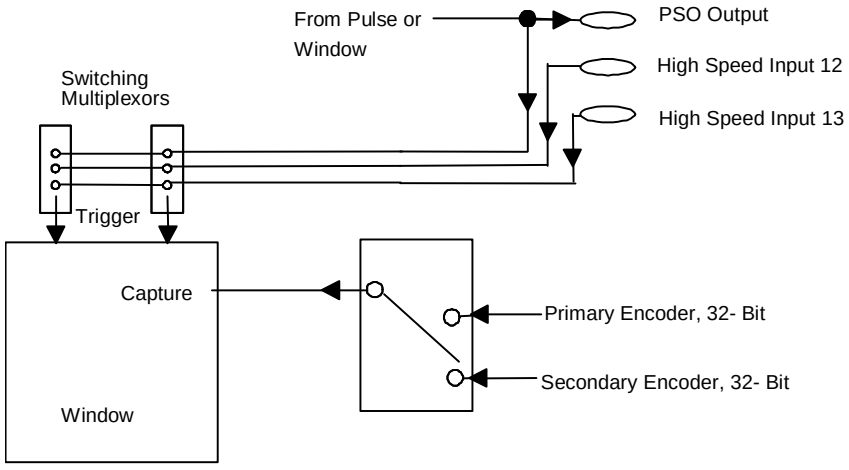
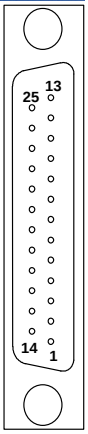


Figure 3-12. Data Capture/Data Update Modes

3.3. Motor Feedback (J103)



The 25-pin D-style connector contains all of the necessary feedback inputs to complete a servo loop. This connector has inputs for a 3-channel encoder, three end-of-travel limit switches, thermistor over-temperature sense input and three Hall effect devices.

The three line driver encoder signals consists of the following: sine (SIN), cosine (COS), and marker (MKR) as well as their complimentary signals: sine-n (SIN-N), cosine-n (COS-N), and marker-n (MKR-N). The encoder input is defined for a differential line driver encoder, in the range of 0 to +5 volts. It allows up to an 8 MHz encoder signal (31 nsec minimum edge separation), producing 32 million counts per second, after multiplying by four (x 4) quadrature decoding. See Figure 3-2 for typical input circuitry of the encoder signals. The Soloist standardly accepts a line driver encoder, or with the -MXU option, an analog sine wave encoder (see Section 3.3.1). See Section 2.8.1. Encoder Phasing, for information on interfacing to non-Aerotech motors.

Two of the three limit inputs are end-of-travel sensing (CW Limit and CCW Limit) while the third is an optional reference limit (Home Limit). Alternatively, opto-isolated user inputs 8-10 may be used as the end-of-travel limit inputs, see Section 3.1.3. The Hall effect switch inputs are recommended for AC brushless motor commutation but not absolutely required. The Hall effect and limit inputs accept 5-24 VDC logic signals. The Pin-outs for the connector are shown in Table 3-11.

The thermistor input is used to detect an over temperature condition in the motor, by a positive temperature coefficient device. That is, as the temperature of the device increases, so does the resistance of the device. Under normal operating conditions, the resistance of the thermistor is low (i.e., 100 ohms). This will be seen as a low input signal. After the temperature causes the thermistor's resistance to increase above 1K ohms, the signal will be seen as a logic high, triggering an over temperature fault by the controllers FaultMasks. See the Soloist HMI help for more information on configuring these FaultMasks.

Table 3-10. Motor Feedback Connector Mating Connector (J103)

	Aerotech	Third party Source
Connector	ECK00101	Cinch P/N DB25P
Back shell	ECK00656	Amphenol P/N 17-1726-2

The Soloist is factory configured for either a square wave differential encoder (default), OR an analog encoder with the -MXU option).

Table 3-11. Motor Feedback Connector Pin out (J103)

Pin #	Label	Description	In/Out/Bi.
1	Frame	Chassis Frame	N/A
2	Thermistor	Motor over temperature Thermistor	Input
3	+5 Volt	+5 Volt Power for Encoder *	Output
4	N.C.	No Connection	N/A
5	HB	Hall Effect Sensor B (Brushless Motors only)	Input
6	Mkr-	Encoder Marker Reference Pulse -	Input
7	Mkr+	Encoder Marker Reference Pulse +	Input
8	Reserved	Reserved	N/A
9	Reserved	Reserved	N/A
10	HA	Hall Effect Sensor A (Brushless Motors only)	Input
11	HC	Hall Effect Sensor C (Brushless Motors only)	Input
12	CW/+ Limit	Clockwise End of travel limit	Input
13	Brake -	Optional Brake - Output	N/A
14	Cos+	Encoder Cosine +	Input
15	Cos-	Encoder Cosine -	Input
16	+5 Volt	+5 Volt Power for Limit Switches *	Output
17	Sin+	Encoder Sine +	Input
18	Sin-	Encoder Sine -	Input
19	Reserved	Reserved	N/A
20	Common	Signal Common for Limit Switches	N/A
21	Common	Signal Common for Encoder	N/A
22	Home Limit	Home Switch Input	Input
23	Enc. Flt.	Encoder Fault	Input
24	CCW/- Limit	Counterclockwise End of travel limit	Input
25	Brake +	Optional Brake + Output	N/A

* Total user +5 V power is limited to 500 mA, by an internal re-settable fuse.

All external power provided by the Soloist to the user is protected by a re-settable fuse. Should an over-current condition occur, the fusing device would open to provide protection against the overload. To reset the device, remove the over-current condition.

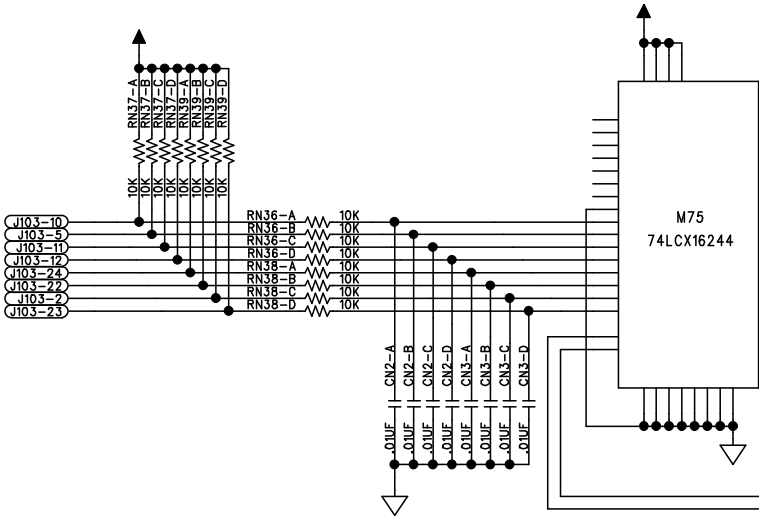
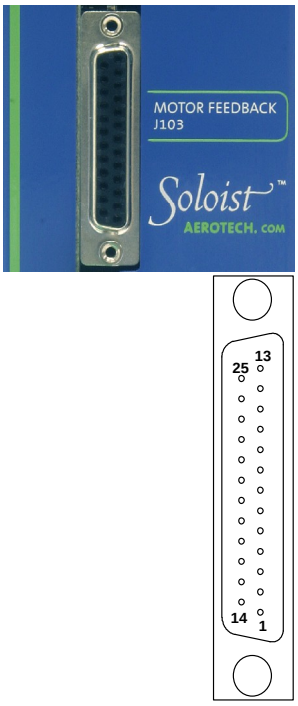


Figure 3-13. Limit, Thermistor and Hall-Effect Inputs (J103)

3.3.1. MXU Option



The MXU encoder input option, is designed for a differential analog encoder in the range of 0.6 to 2 volts (Peak to Peak). The maximum input frequency is limited to 200 kHz. The MXU option multiplies the resolution programmatically up to 512 times (total). The multiplication factor is defined by the CfgFbkEncMultFactorMXU axis parameter.

The encoder input should be adjusted for optimum performance by the CfgFbkEncCosGain, CfgFbkEncCosOffset, CfgFbkEncPhase, CfgFbkEncSineGain, CfgFbkEncSineOffset, CfgFbkEncMultFactorMXU axis parameters. This can be done automatically using the Encoder Feedback Configuration utility. See the Soloist HMI help for more information.

The MXU option is not compatible with PSO firing capabilities because it does not generate a serial pulse stream as required by the PSO (Position Synchronized Output) option.

A standard differential line driver encoder must be used if this option is not present, see Section 3.3. for more information. See the figure below for MXU typical input circuitry. The pin out is indicated in Table 3-11.

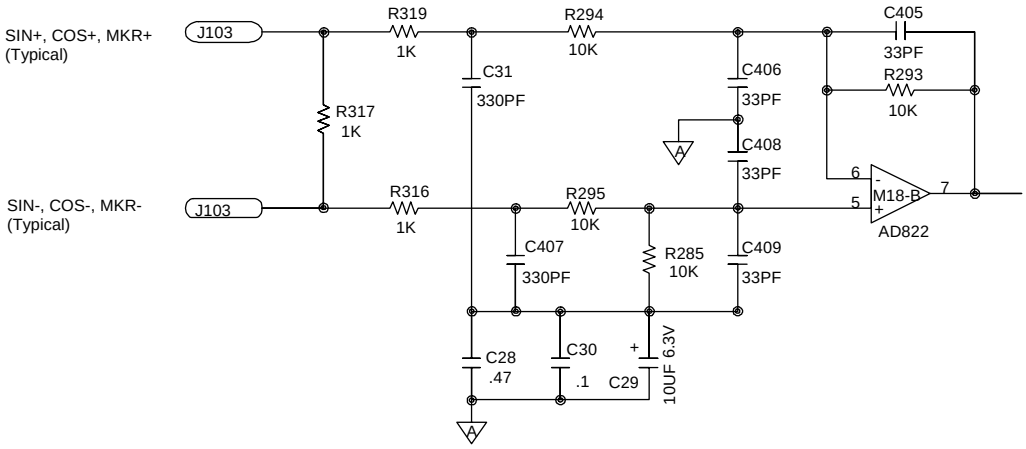
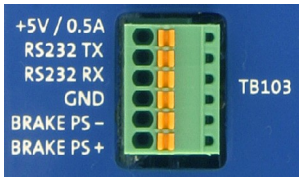


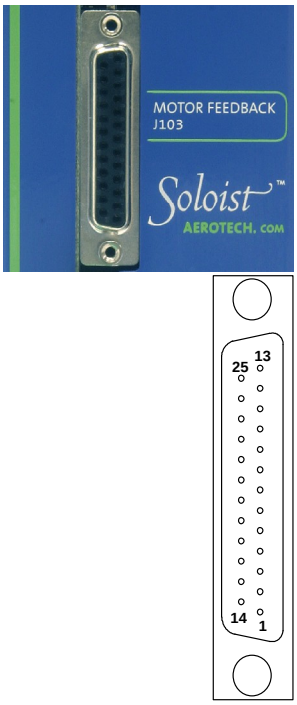
Figure 3-14. Optional -MXU Analog Encoder Interface (J103)

3.3.2. Brake / Relay Interface (J103, TB103)



The brake relay is typically used to power a failsafe electromagnetic brake on a vertical axis. This causes the brake to be engaged, holding the axis in position, unless it is powered. Note, that the axis may move slightly as the brake is enabled and disabled but will never drift or fall down. The design also allows the brake to be powered through the existing encoder feedback cable without the need for additional wiring, as indicated in Figure 3-15. Failsafe brakes used by Aerotech require a 24 VDC supply capable of supplying 1 ampere of current.

This brake output may also be used as a general-purpose relay. For this reason, the normally closed, normally open and common contacts are available on the TB206 connector of the -IO option.



See the BrakeOnDriveDisable axis parameter for information on activating the brake output automatically, or the BRAKE command for manually toggling the output, both in the Soloist help.

See Section 4.2.6. in Chapter 4, for more information on using the brake output.

See Section 3.3. for the J103 mating connector part number.

Table 3-12. Brake Power Input Pin-out on Connector TB103

Pin #	Label	Description	In/Out/Bi.
5	Brake Power -	Optional Brake Power Input	Input
6	Brake Power +	Optional Brake Power Input	Input

Table 3-13. Brake/Relay Output Pin-out on Connector J103

Pin #	Label	Description	In/Out/Bi.
13	Brake -	Optional Brake Relay - Output	Output
25	Brake +	Optional Brake Relay + Output	Output

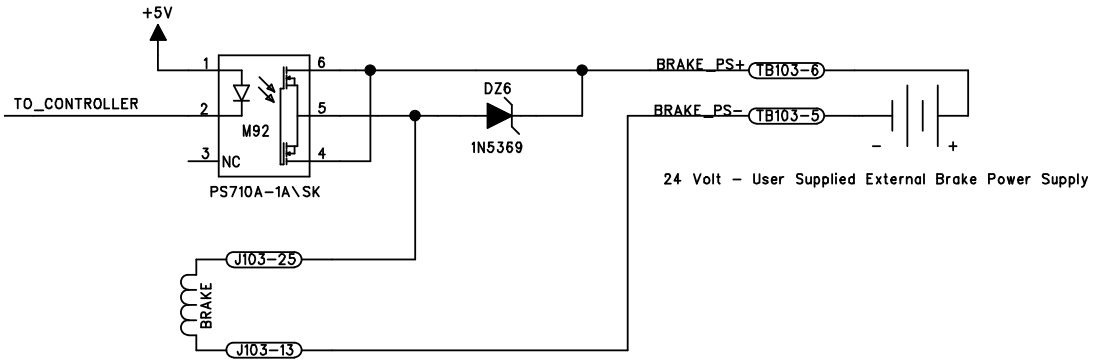


Figure 3-15. Brake Connector (TB103)

3.4. RS-232 Serial Port (TB103)

The RS-232C port is shown in Figure 3-16. Connecting the RS-232 port to a user's PC requires only a standard 9-pin cable (not a null modem).

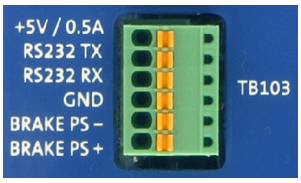


Table 3-14. TB103 RS-232 Connector Pin-out

Pin #	Label	Description	In/Out/Bi.
1	+5 Volt	+5 Volt Power Output *	Output
2	RS-232 TXD	RS-232 Transmit Output	Output
3	RS-232 RXD	RS-232 Receive Input	Input
4	Common	Signal Common	N/A

* Total user +5 V power is limited to 500 mA, by an internal re-settable fuse.

Table 3-15. RS-232 Port Connector Mating Connector (TB103)

	Aerotech	Third Party Source
6 pin connector	ECK01364	Phoenix FK-MC0.5/6-ST-2.5 #1881367

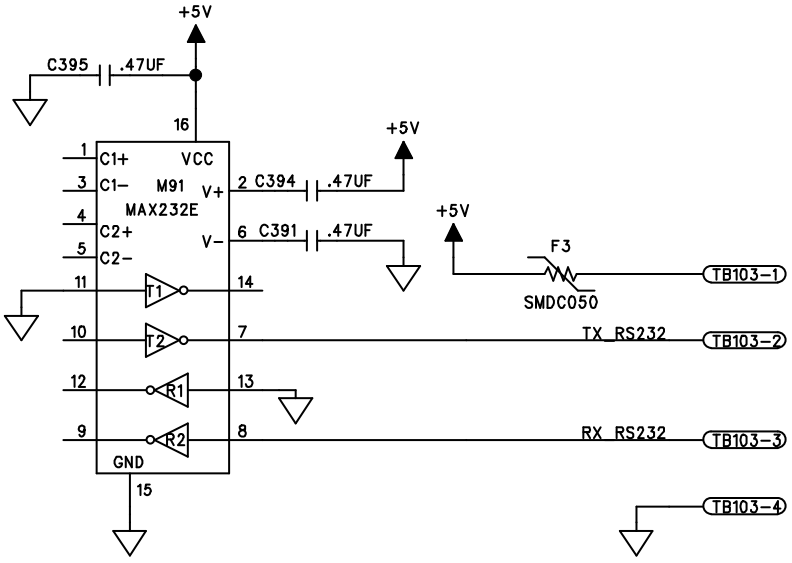
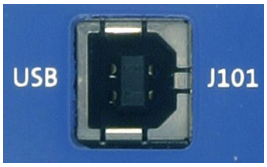


Figure 3-16. RS-232 Connector (TB103)

3.5. USB Port (J101)*



The USB port has all of the same functionality as the Ethernet interface for Aerotech's utilities. The Ethernet port however, does have some additional features for non-Aerotech devices.

* Planned Feature, Consult Aerotech Inc. for availability.

CHAPTER 4: SOLOIST OPTIONS

In This Section:

- Introduction 4-1
- -IO Option Board 4-2
- Analog Input 1 (TB201) 4-2
- Analog Output 1 (TB201).....4-3
- Port 1 and Port 2 Opto-Isolated Outputs (TB202, TB203)...4-4
- Port 1 and Port 2 Opto-Isolated Inputs (TB204, TB205).....4-6
- User Power (TB204, TB205).....4-9
- Brake / Relay (TB206).....4-9

4.1. Introduction

The following options are available for the Soloist.

Table 4-1. Soloist Options

Option	Capabilities
-AUXPWR	Separate control power input for the 20-80VDC bus as described in Chapter 2, section 2.4.2.
-MXU	Analog encoder x512 encoder resolution multiplier option, See Chapter 3.
-S	Shunt option (standard on Soloist30)
-IO	-IO Option Board, add 16 digital opto-inputs, 16 digital opto-outputs, 1 analog input, 1 analog output and a brake/relay output.
-S	Shunt regulator for regenerative energy dissipation.
-LB	Low bus voltage option for 40-100 VDC bus; does not support keep-alive functionality; not available with -AUXPWR option; 40-100 VDC bus operation requires external transformer to generate 28-70 VAC bus power input.
JI	Industrial Joystick.

4.2. -IO Option Board

See the following sections for details on the connector Pin-out and technical information for the -IO options.

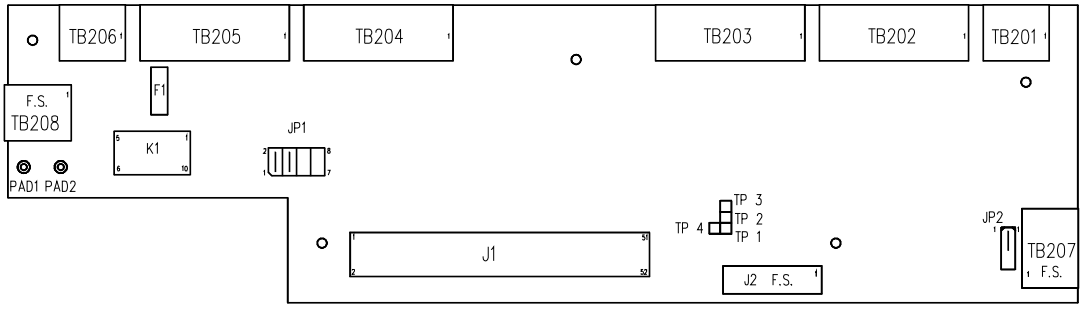
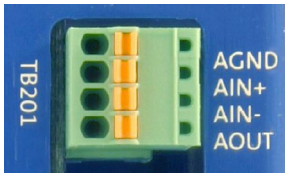


Figure 4-1. -IO Option Board (690D1611 Rev. 0)

4.2.1. Analog Input 1 (TB201)



Analog input 1 is differential and buffered by a precision unity gain differential AD622 instrumentation amplifier and converted to digital by a 12-bit ADS7816 analog to digital converter allowing an input voltage in the range of +/- 10 volts. This produces a resolution of 4.88 millivolts per bit of the A/D. Refer to Figure 4-2. To interface to a single-ended (non-differential) voltage, ground the negative (-) input and connect your signal to the positive (+) input. Analog input 0 is available at J104, see section 3.1.5. The analog input has a 10 Giga-ohm input impedance.

Table 4-2. Optional Analog Input Connector Pin-out (TB201)

Pin #	Label	Description	In/Out/Bi.
1	AGND	Analog Common	N/A
2	AIN1+	Non-Inverting Analog Input 1	Input
3	AIN1 -	Inverting Analog Input 1	Input

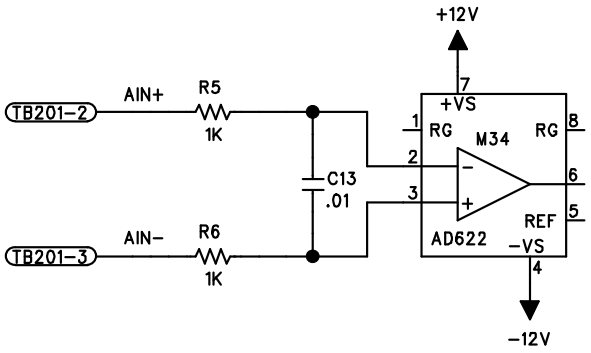
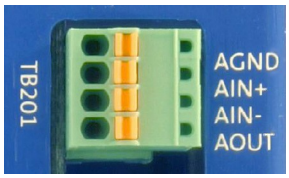


Figure 4-2. Optional Analog Input Connector (TB201)

4.2.2. Analog Output 1 (TB201)



Analog output 1 is driven by a 16-bit DAC8531 digital to analog converter and buffered by a TL084 op-amp, producing a single-ended output voltage in the range of +/- 10 volts. This produces a resolution of 305 uVolts per bit of the D/A. The output current is limited to less than 50 mA. Note that the analog outputs are referenced to TB201-1. Analog output 0 is present on J104, see Section 3.1.4. The analog outputs will be zero volts during reset.

Table 4-3. Analog Output Connector Pin-out (TB201)

Pin #	Label	Description	In/Out/Bi.
1	AGND	Analog Common	N.A.
4	AOUT 1	Analog Output 1	Output

The analog output common may be found at J103 pin 23 or TB201 pin 1.

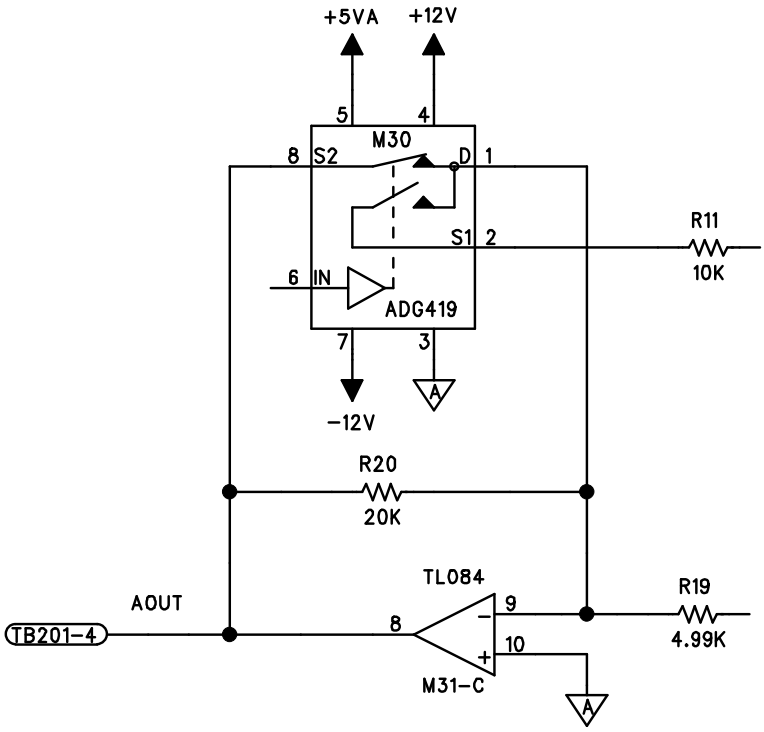


Figure 4-3. Analog Output Connector (TB201)

4.2.3. Port 1 and Port 2 Opto-Isolated Outputs (TB202, TB203)

The digital outputs are software configurable by the DriveIOConfig axis parameter as sourcing or sinking. All outputs must all be connected as sourcing, or all as sinking. The outputs are driven by PS2802-4 opto-isolators that are rated for 40 volts maximum and up to 80 mA/channel, not to exceed 90 mW per channel. Figure 4-4 and Figure 4-5 illustrate how to connect to an output in current sinking and current sourcing modes, respectively. Four additional outputs are on J104.

> Note that the connection must always be made to both the OP and OM connections to prevent glitches on the outputs, as shown in Figure 4-4 and Figure 4-5.

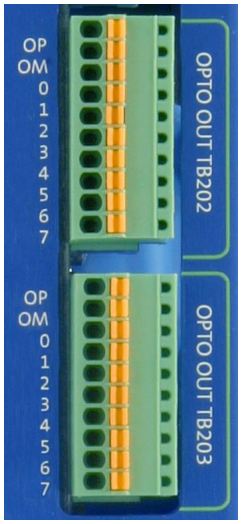


Table 4-4. Port 1 Opto-Isolated Output Connector Pin-out (TB202)

Pin #	Label	Description	In/Out/Bi
1	OP	Output Common Plus (for TB202)	Input
2	OM	Output Common Minus (for TB202)	Input
3	Output 0	Output 0 (Optically-Isolated)	Output
4	Output 1	Output 1 (Optically-Isolated)	Output
5	Output 2	Output 2 (Optically-Isolated)	Output
6	Output 3	Output 3 (Optically-Isolated)	Output
7	Output 4	Output 4 (Optically-Isolated)	Output
8	Output 5	Output 5 (Optically-Isolated)	Output
9	Output 6	Output 6 (Optically-Isolated)	Output
10	Output 7	Output 7 (Optically-Isolated)	Output

Table 4-5. Port 2 Opto-Isolated Output Connector Pin-out (TB203)

Pin #	Label	Description	In/Out/Bi
1	OP	Output Common Plus (for TB203)	Input
2	OM	Output Common Minus (for TB203)	Input
3	Output 0	Output 0 (Optically-Isolated)	Output
4	Output 1	Output 1 (Optically-Isolated)	Output
5	Output 2	Output 2 (Optically-Isolated)	Output
6	Output 3	Output 3 (Optically-Isolated)	Output
7	Output 4	Output 4 (Optically-Isolated)	Output
8	Output 5	Output 5 (Optically-Isolated)	Output
9	Output 6	Output 6 (Optically-Isolated)	Output
10	Output 7	Output 7 (Optically-Isolated)	Output

Table 4-6. Output Specifications (TB202, TB203)

Specification	Value
Maximum Power Dissipation	90 mWatts / Channel
Maximum Voltage	40 Volt Maximum
Maximum Sink/Source Current	80 mAmps / Channel
Output Saturation Voltage	~ 0.7 □0.9 Volts
Rise / Fall Time	250 usec (typical)
Maximum Output Frequency	1 kHz

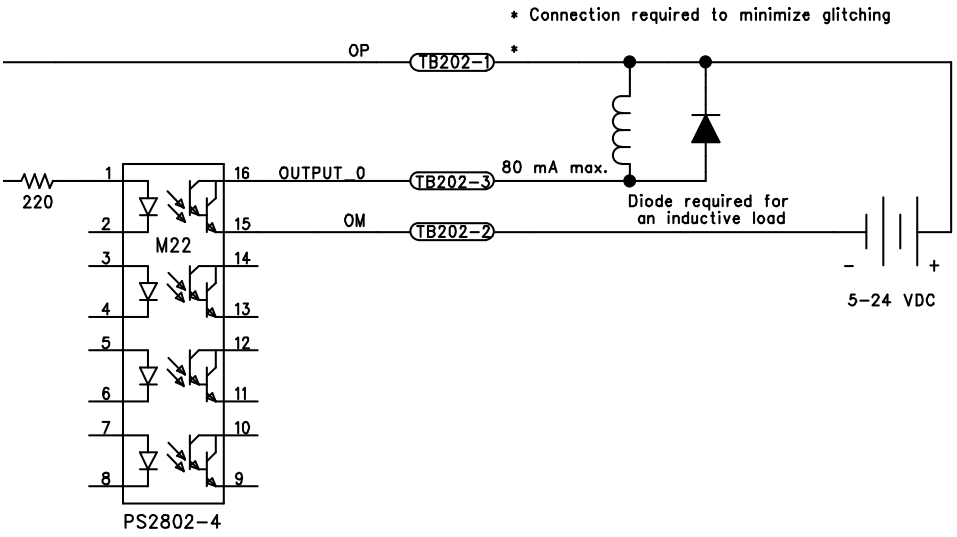


Figure 4-4. Connecting Outputs in Current Sinking Mode

Be sure to set the DriveIOConfig axis parameter, to configure the outputs as current sinking or current sourcing !

All outputs on a single port (0, 1 or 2) must be connected as all sourcing, or as all sinking outputs.

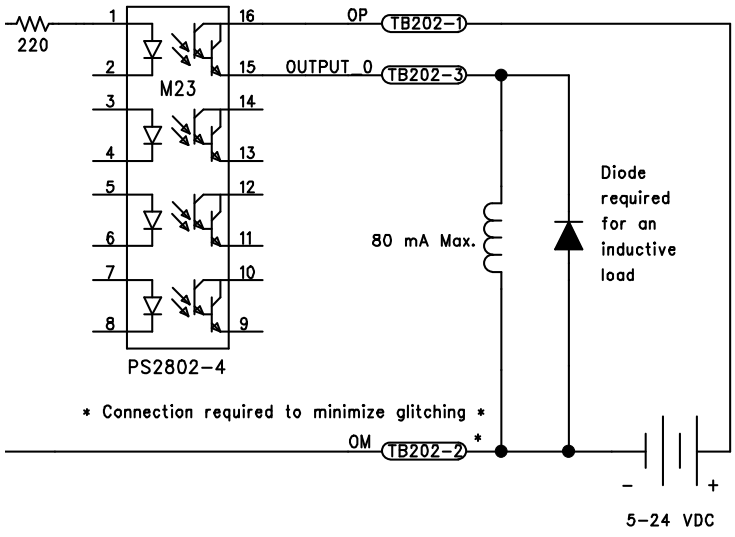
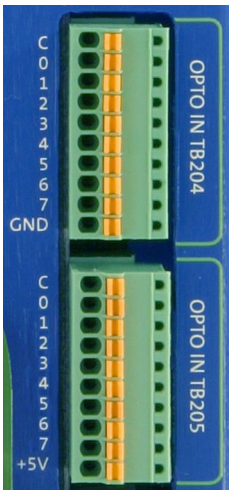


Figure 4-5. Connecting Outputs in Current Sourcing Mode

Suppression diodes must be installed on outputs that are used to drive relays or other inductive devices to protect the output devices from being damaged by the inductive spikes that occur when the device is turned off. Suppressor diodes can be installed on all outputs to provide greater protection. The 1N914 diode is recommended for this application. It is important that the diode be installed correctly (normally reversed biased). See Figure 4-4 for an example of a current sinking output with diode suppression and Figure 4-5 for an example of a current sourcing output with diode suppression.



4.2.4. Port 1 and Port 2 Opto-Isolated Inputs (TB204, TB205)

The digital inputs are configured for 5-24 volt logic. Using a higher input voltage, requires adding external series resistors to limit the current. The opto-isolator is a PS2806L-4 device. The inputs may be connected to current sourcing or current sinking devices, as shown in Figure 4-6 and Figure 4-7. Each 8-bit bank of inputs (TB204 and TB205) must be connected to either all current sourcing or all current sinking devices. Also, note in the tables below that inputs TB204 and TB205 have two different common inputs at Pin #1, respectively. See Section 3.1.3. for opto-isolated EOT limit inputs.

Table 4-7. Port 1 Opto-Isolated Input Connector Pin-out (TB204)

Pin #	Label	Description	In/Out/Bi
1	C	Input Common for inputs 0 □7 (TB204)	Input
2	Input 0	Input 0 (Optically-Isolated) □See pin 1	Input
3	Input 1	Input 1 (Optically-Isolated) □See pin 1	Input
4	Input 2	Input 2 (Optically-Isolated) □See pin 1	Input
5	Input 3	Input 3 (Optically-Isolated) □See pin 1	Input
6	Input 4	Input 4 (Optically-Isolated) □See pin 1	Input
7	Input 5	Input 5 (Optically-Isolated) □See pin 1	Input
8	Input 6	Input 6 (Optically-Isolated) □See pin 1	Input
9	Input 7	Input 7 (Optically-Isolated) □See pin 1	Input
10	GND	Signal Common	N.A.

Inputs 0 - 7 on each Port (0, 1 and 2) must be used in all current sourcing or all current sinking mode. No combination of these two modes is allowed.

Table 4-8. Port 2 Opto-Isolated Input Connector Pin-out (TB205)

Pin #	Label	Description	In/Out/Bi
1	C	Input Common for inputs 0-7 (TB205)	Input
2	Input 0	Input 0 (Optically-Isolated) □See pin 1	Input
3	Input 1	Input 1 (Optically-Isolated) □See pin 1	Input
4	Input 2	Input 2 (Optically-Isolated) □See pin 1	Input
5	Input 3	Input 3 (Optically-Isolated) □See pin 1	Input
6	Input 4	Input 4 (Optically-Isolated) □See pin 1	Input
7	Input 5	Input 5 (Optically-Isolated) □See pin 1	Input
8	Input 6	Input 6 (Optically-Isolated) □See pin 1	Input
9	Input 7	Input 7 (Optically-Isolated) □See pin 1	Input
10	+5V	Internal +5 Volt Power Supply *	N.A.

* Total user +5V power is limited to 500mA by an internal re-settable fuse.

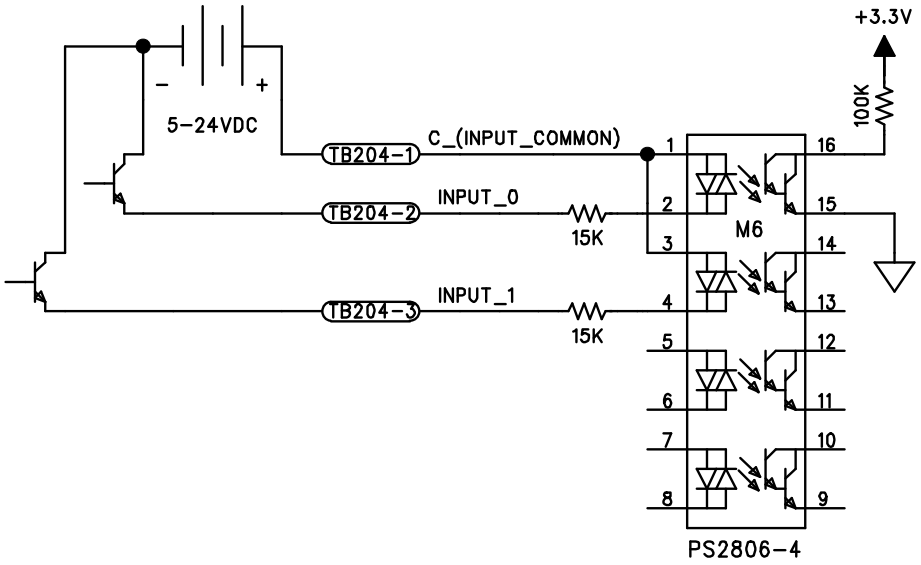


Figure 4-6. Inputs Connected in Current Sourcing Mode

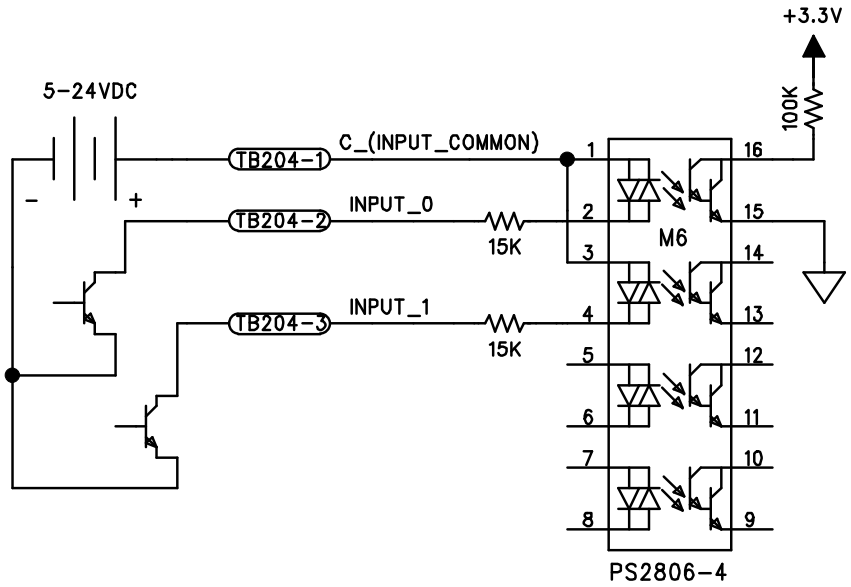


Figure 4-7. Inputs Connected in Current Sinking Mode

4.2.5. User Power (TB204, TB205)

Pin 10 of TB204 provides the common return for the user power from the Soloist's internal power supply.

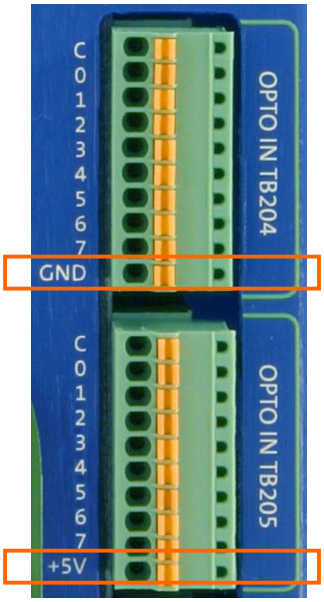


Table 4-9. User Common Connector Pin out (TB204)

Pin #	Label	Description	In/Out/Bi
10	GND	User Common (for user +5 VDC power)	N.A

Pin 10 of TB205 provides +5 VDC power to the user from the Soloist's internal power supply, which may be used to power external devices (3 Amps maximum).

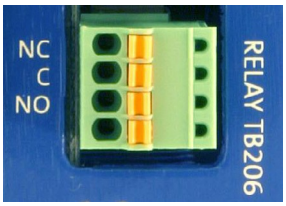
Table 4-10. +5 Volt Power Connector Pin out (TB205)

Pin #	Label	Description	In/Out/Bi
10	+5V	User +5 Volt Power *	Output

* Total user +5V power is limited to 500mA by an internal re-settable fuse.

4.2.6. Brake / Relay (TB206)

The relay output is typically used to automatically drive a fail-safe brake on a vertical axis, however, it may also be used as a general purpose relay. See the BrakeOnDriveDisable axis parameter for information on activating the brake output automatically, or the BRAKE command for manually toggling the output, both in the Soloist help. The brake/relay output is available at the J103 connector and TB206. In order to help the user to interface to the brake relay the remainder of this section will be presented as a step-by-step procedure.



The N.C. terminal is the Normally Closed relay contact, the N.O. terminal is the normally open contact and the C terminal is the Common contact, switched between the other two terminals.

Table 4-11. IOPSO Option Board Jumpers

Jumper #	Setting	Description
JP1	1-2, 3-4*	Switch Brake - Output at J103 Pin 13 (Remove 1-3, 5-6 and 7-8)
	5-6, 7-8	Switch Brake + Output at J103 Pin 25 (Remove 1-3, 1-2 and 3-4)
	1-3	Auxiliary relay Output Option at TB206 (Remove 1-2, 3-4, 5-6 and 7-8)

* factory default setting

4.2.6.1. Brake Configuration Jumpers

The configuration of JP1, as shown in the table above allows either the Brake + or the Brake - output to be switched by the relay and connected at the J103 motor feedback connector, or for the brake to be connected at TB206. See Figure 4-8 in section 4.2.2. for more information.

Step #1 Brake Relay Specifications

The user must verify that the application will be within the specifications of the Brake Relay contacts. These specifications are provided below in Table 4-12.

Table 4-12. Voltage and Current Specifications (TB206)

Relay K1 Contact Ratings	
Maximum Switched Voltage	150 VDC, 125 VAC
Maximum Switched Current	1A
Maximum Carrying Current	1A
Maximum Switched Power	30W (DC), 60 VA (AC)
Note: The maximum power that may be switched is voltage dependent.	
Initial Contact Resistance	50 milliohms max. @ 10 mA, 6 VDC

The user must not exceed the Maximum Current or Maximum Power specifications.

Step #2 Select Brake Interface Connector

The Normally Open Brake Relay Contacts are accessible through TB206 and the Motor Feedback connector (J103). The Brake Relay Normally Closed Contact is only accessible through TB206 (see Figure 4-8). The Motor Feedback connector (J103) allows the brake wires to be included in the motor feedback cable and eliminate the need for a separate brake cable. The Brake Relay connections to TB206 are listed in Table 4-13 and the Brake Relay connections to the Motor Feedback connector (J103) are listed in Table 4-14.

Table 4-13. Brake / Relay Connector Pin-out (TB206)

Pin #	Label	Description	In/Out
3	Relay-N.C.	Brake Relay Output Normally Closed Contact	Output
4	Relay-Com.	Brake Relay Output Common Contact	Output
5	Relay-N.O.	Brake Relay Output Normally Open Contact (See JP1)	Output

Table 4-14. Brake / Relay Connector Pin-out (J103)

Pin #	Label	Description	In/Out/Bi.
13	BRK-	Brake- Relay Output Normally Open Contact (See JP1)	Output
25	BRK+	Brake+ Power connection (See JP1)	Output

Figure 4-8 is an example of a +24 VDC Brake connected to TB206. In this example, JP1 must be set 1-3 and all other jumpers removed. Otherwise, the user must connect J103 pin 13 to J103 pin 25. In this case, J103 would function as an interlock to prevent the Brake from releasing, if the Motor Feedback connector is not connected.

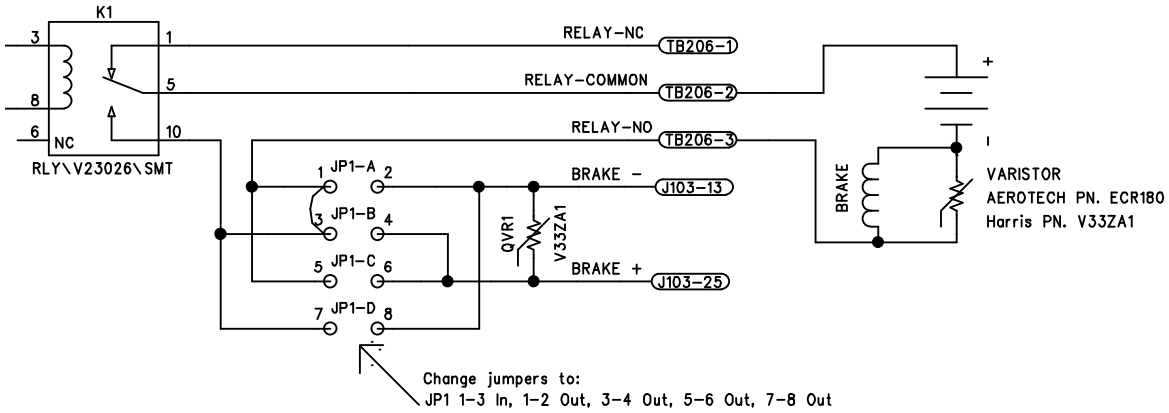


Figure 4-8. Brake Connected to TB206

Figure 4-9 is an example of a +24 VDC Brake connected to J103, the Motor Feedback connector. In this example the external +24 power source is connected to TB206. Also note that JP1 is set 1-2 and 3-4, with all others removed.

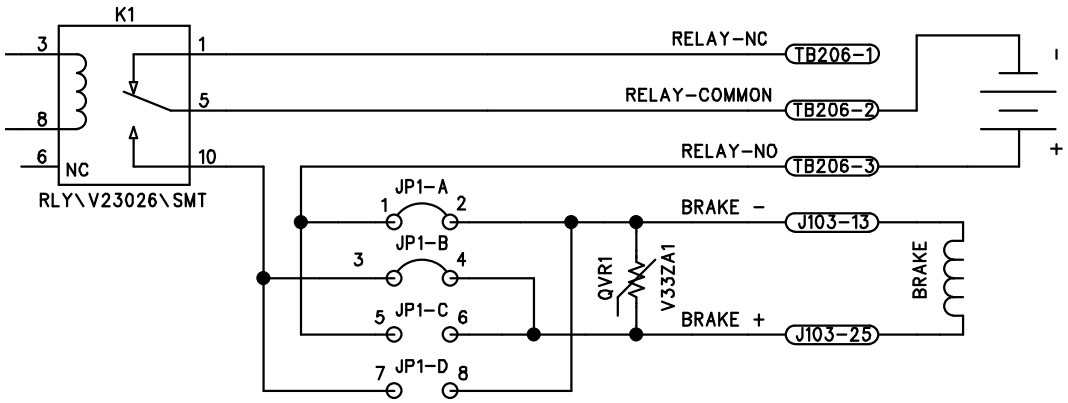


Figure 4-9. Brake Connected to J103

The user is responsible for providing fuse protection for the Brake circuit.

Step #3 Suppression and Snubber requirements

Due to the inductive effects of the load (brake) suppression and/or snubber, components are needed to reduce arching and prevent damage to the Brake Relay contacts. Suppression can also reduce the electrical noise that is emitted when a circuit is turned off. Following are three suppression circuit examples.

Example #1: Figure 4-8 is an example of a typical 24 VDC brake circuit. In that example, the suppression component is the Varistor connected across the brake. This method of suppression is used for systems operating at voltages up to 25 VDC and AC systems operating at voltages up to 18 VAC. If the voltage is greater than 25 VDC or 18 VAC, one of the other methods should be used.

Example #2: Figure 4-10 is a suppression circuit that can be used for both AC and DC systems. In this method, a resistor, capacitor and a varistor are combined and placed across the load (see Figure 4-10). In some cases, better results are obtained by installing the suppressor circuit across the contacts. The ratings and values for these components are described below.

Resistor (R): is calculated by the following formula, Watt rating = □ Watt.

R(ohms) = Voltage / Load current

If R is less than 24 ohms use 24 ohm resistor.
If R is greater than 240 ohms use 240 ohm resistor.
If the resistance of R is too low the relay contacts may weld together.
If the resistance of R is too high the contacts may be damaged due to excessive arching.

Capacitor (C): .1 uF, rated for AC, and a voltage rating of not less than 250 Volts. If the voltage rating of the capacitor is too low, the Varistor may not be able to protect it and it may fail.

Varistor (V): Rated for the maximum voltage of the external supply being used. Typically, a varistor rated for a standard 120 VAC line should work. Verify that the capacitor voltage rating is greater than the clamping voltage of the varistor. If the voltage rating of the varistor is too low, it may conduct during normal operation and overheat. If the voltage rating of the varistor is too high, it may not protect the capacitor (C) against over-voltage conditions.

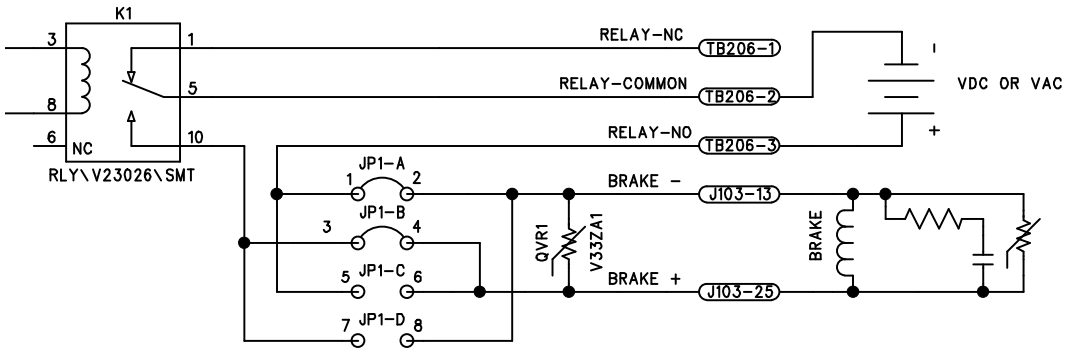


Figure 4-10. Suppression for DC Brake Systems

CHAPTER 5: ACCESSORIES

In This Section:

- Standard Interconnection Cables 5-1
- Joystick Interface 5-5
- Handwheel Interface 5-7

5.1. Standard Interconnection Cables

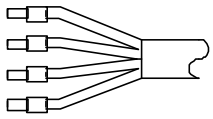
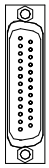
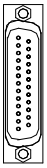
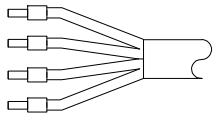
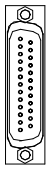
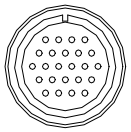
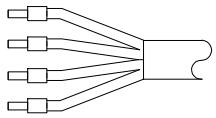
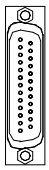
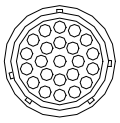
The following three tables show a summary of the standard cables used for interconnecting various items to the Soloist. The -xx, in the tables below, is used to specify the length in decimeters; -yy specifies the length in feet.

To identify your cable or for a wiring drawing, see your Soloist software CD- ROM.

Table 5-1. Standard Interconnection Cables

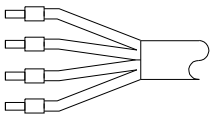
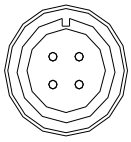
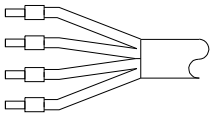
Cable Part #	Description
C13803-xx	DC Brush Motor Cable (DC MTR & FB-25DU FL-24MS-MAX107DM)
C15291-xx	Encoder Feedback Cable (BL FB-25DU-17MS 9DU-MAX120DM)
C15805-xx	Motor Cable (BL MTR FL 4MS)
C1650X	Encoder Feedback Cable (BL FB-25DU-25DU-MAX120DM)
C1839X	Encoder Feedback Cable (BL FB-25DU-25DU 9DU-MAX120DM)
C18982	Motor and Encoder Feedback Cable (BL MTR&FB-FL-25DU-25DU-107DM MAX)
C19360-xx	Motor Cable (BL MTR-FL-4DU-MAX450DM)
C19791	Joystick Extension Cable with Flying Leads (JSXT-FLY-XX)
C19792	Joystick Extension Cable with D Style Connectors (JSXT-26HD-XX)
C19851	Hi-Flex Motor Cable (BL MTR-FL-4DU-HF-46DM)
C20251-xx	Stepper Motor Cable
ECZ01231	BBA32 Interconnect Cable

Table 5-2. Combined Motor & Feedback Cables

Soloist	Part Number (s)	Description	Stage/Motor
 Motor Output  Motor Feedback	C18982-xx* BFMCDNT-yy*	BL MTR & FB-25DU FL-25DU-MAX107DM Obsolete	 Motor/Encoder / Limits / Halls
	Used On: Any brushless motor stage having a single 25 pin "D" style connector for motor power, encoder, limits and halls. ABL1000 series ALS130 & ALS135 series (Single connector version) ANT series, AVL125, & ADR175 ASR1000, 1100, & 2000 series (with "25D option)		
 Motor Output  Motor Feedback	C13803-xx*	DC MTR & FB-25DU FL-24MS-MAX107DM	 Motor/Encoder / Limits / Brake
	Used On: Any stage having a DC brush motor with a single 24 pin "MS" style connector for motor power, encoder, limits and brake.		
 Motor Output  Motor Feedback	C20251-xx*	SM MTR & FB-25DU FL-23B-MAX107DM	 Motor/Encoder / Limits / Brake
	Used On: Any stage having a stepper motor with a single 23 pin Burndy style connector for motor power, encoder, limits and brake.		

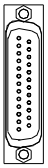
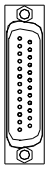
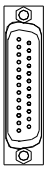
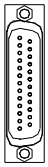
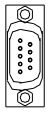
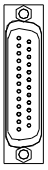
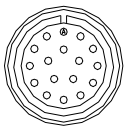
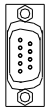
* The "xx" indicates length measured in decimeters "yy" indicates length measured in feet.

Table 5-3. Individual Motor Cables

Soloist	Part Number (s)	Description	Stage/Motor
 Motor Output	C15805-xx* PMCNT-yy*	BL MTR-FL-4MS-MAX450DM Obsolete	 Motor
	Used On: Any brushless motor stage having a 4 pin "MS" style connector for motor power. BM/BMS motors (with -MS option) BMxxxE motors		
 Motor Output	C19360-xx* PMCHPDNT-yy*	BL MTR-FL-4DU-MAX450DM Obsolete	 Motor
	Used On: Any brushless motor stage having a 4 pin "D" style connector for motor power. BM/BMS motors (with -D25 option) ABL2000 & 8000 series ABR1000 Series ADR160 - 240 series ADRT series ALA1000 series ALS130, 135, 2200, 3600, 5000, 5000WB, 20000, & 25000 series ARA125 series ASR1000, 1100, & 2000 series (with "HPD option) ATS1100-H series LMA & LMAC series		

* The "xx" indicates length measured in decimeters "yy" indicates length measured in feet.

Table 5-4. Individual Feedback Cables

Soloist	Part Number (s)	Description	Stage/Motor
 Motor Feedback	C16501-xx* C16505-xx* BFCMX-yy *	BL FB-25DU-25DU-MAX120DM BL FB-25DU-25DU-MAX240DM Obsolete	 Encoder/Limits / Halls / Brake
	Used On: Any brushless motor stage having a 25 pin □D□style connector for encoder, limits, halls and brake. BM/BMS motors (with -D25 option) ABL2000 & 8000 series ABR1000 Series ADR160 - 240 series ADRT series ALA1000 series ALS130, 135, 2200, 3600, 5000, 5000WB, 20000, & 25000 series ARA125 series ASR1000, 1100, & 2000 series (with □HPD option) ATS1100-H series LMA & LMAC series		
 Motor Feedback	C18391-xx* C18393-xx* BFCD-yy*	BL FB-25DU-25DU 9DU-MAX120DM BL FB-25DU-25DU 9DU-MAX240DM Obsolete	 Encoder / Halls / Brake  Limits
	Used On: Any Brushless motor stage having a 25 pin □D□style connector for encoder, halls, & brake and a 9 pin □D□connector for limits. BM/BMS motors (with □D25 option)		
 Motor Feedback	C15291-xx* C15297-xx* BFC-yy*	BL FB-25DU-17MS 9DU-MAX120DM BL FB-25DU-17MS 9DU-MAX240DM Obsolete	 Encoder / Halls / Brake  Limits
	Used On: Any stage having a BM/BMS motor with a 17 pin □MS□style connector for encoder, halls, & brake and a 9 pin □D□connector for limits.		

* The □xx□indicates length measured in decimeters □yy□indicates length measured in feet.

5.2. Joystick Interface

The user may connect an Aerotech JI (not JBV, or JP4) joystick or their own joystick and switches to the Soloist (Refer to Figure 5-1). The joystick interlock input in the logic low state may be used to detect the presence of the joystick. The zero velocity null-point for each joystick is approximately 2.5 volts. A two-axis joystick requires 2 analog inputs. Each Soloist has only one analog input, unless the -IO option board is present, so two Soloists may be used for a two-axis joystick.

Subsequent drawings illustrate how to connect the joystick (both single and two-axis) to the Soloist in various ways, and the cables required to so do.

If two separate Soloists are being used to read the joystick, only one Soloist should be used to provide 5 Volt power to the potentiometers. The second Soloist should connect differentially to the second joystick potentiometer by connecting Analog Input- to common and Analog Input+ to the potentiometers wiper, as shown in the following figure.

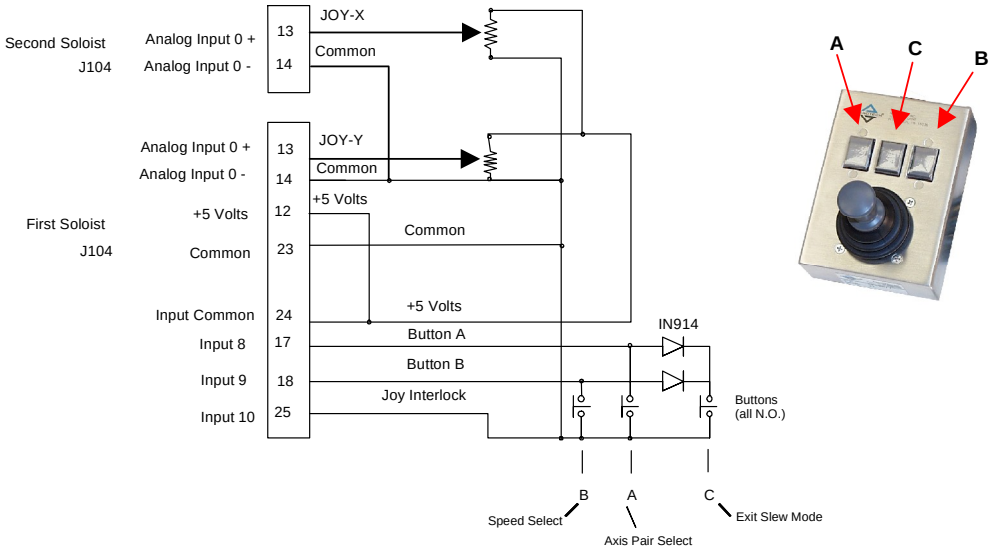


Figure 5-1. Joystick Interface

A standard Aerotech JI joystick may be connected to J104 of the Soloist as a single axis joystick through the following cable, shown below (Figure 5-2 and Figure 5-3). Figure 5-2 indicates the required cable and Figure 5-3 indicates the interconnection of the joystick to the Soloist.

The following drawings (Figure 5-2 and Figure 5-3) are shown for reference only and were complete and accurate as of this manual's release. The most recent .Dwg files and a viewer may be found on your software CD ROM.

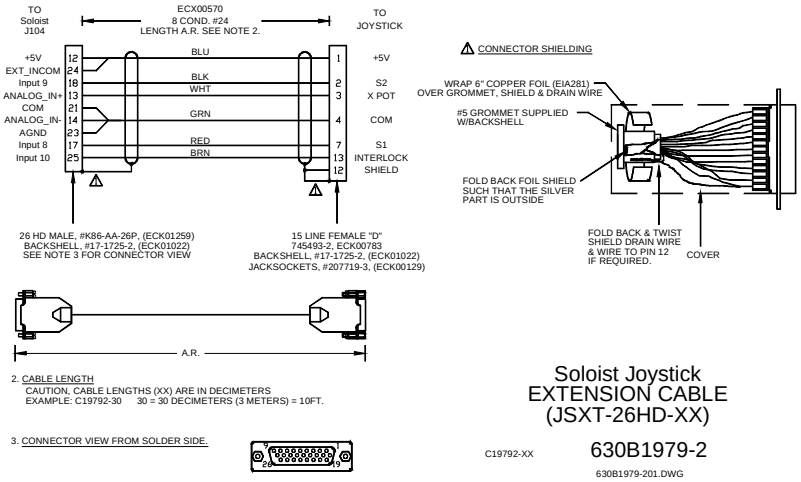


Figure 5-2. Single Axis Joystick Interface to J104 of the Soloist

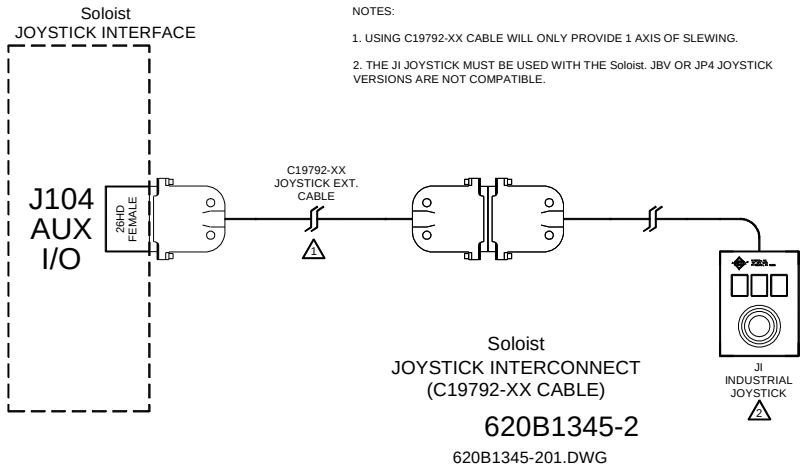


Figure 5-3. Single Axis Joystick Interconnect to J104 of the Soloist

5.3. Handwheel Interface

The user may connect a handwheel or any device producing differential quadrature signals for manual positioning of the axes. See the Soloist Help for information on the Gear command to enable the handwheel. The handwheel may be connected to J104 of the Soloist as shown in Figure 5-4, below.

The following drawing (Figure 5-4) is shown for reference only and was complete and accurate as of this manual's release. The most recent .Dwg files and a viewer may be found on your software CD ROM.

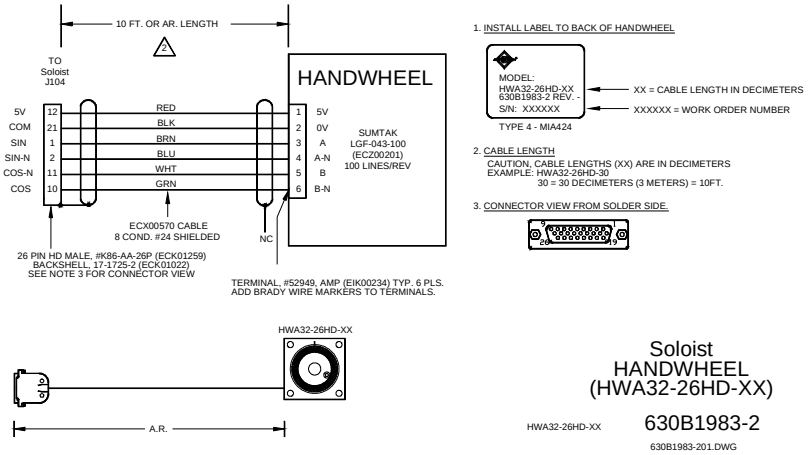


Figure 5-4. Handwheel Interconnection to J104 of the Soloist

A handwheel with flying leads (no connector) may also be connected to the Soloist through the Aerotech BBA32 to J104, per the next two drawings.

The following drawings (Figure 5-5 and Figure 5-6) are shown for reference only and were complete and accurate as of this manual's release. The most recent .dwg files and a viewer may be found on your software CD ROM.

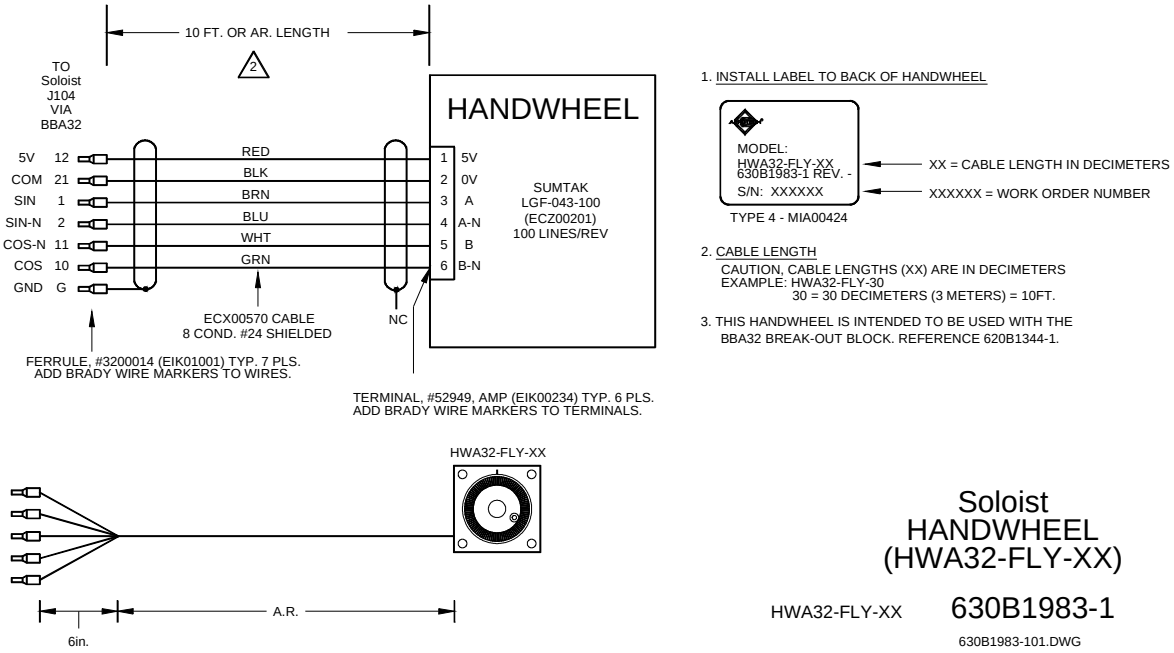


Figure 5-5. Handwheel with Flying Leads (No Connector)

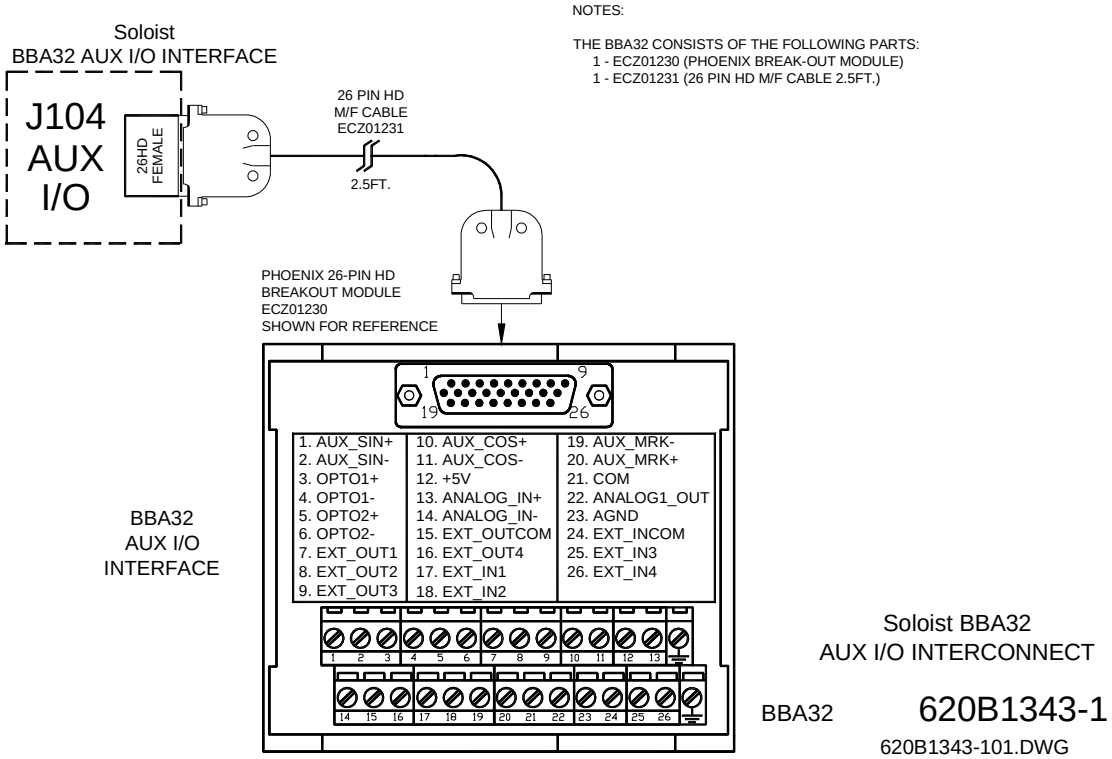


Figure 5-6. BBA32 Interface Used to Connect a Handwheel with Flying Leads (No Connector)

CHAPTER 6: TROUBLESHOOTING

In This Section:

- Problems, Causes, and Solutions.....6-1
- Soloist Test Points 6-3
- Fuse Replacement 6-4
- Soloist Board Assembly.....6-5
- Preventative Maintenance 6-7

6.1. Problems, Causes, and Solutions

This section covers symptoms, probable causes, and solutions related to Soloist operation. Table 6-1 lists the most common symptoms of irregular operation and the possible causes and solutions for these faults. More information can be found in the Soloist HMI help.

Before performing the tests described in Table 6-1, be aware of lethal voltages inside the controller and at the input and output power connections. A qualified service technician or electrician should perform these tests.

No user serviceable parts inside.

Motor/Soloist chassis may exceed 50 C.

Disconnect power to the Soloist main supply and optional supply before servicing.

Hazardous voltages may be present at Mains inlet and motor connectors.

Voltages must be mechanically secured before applying power.

Motors must be mechanically secured before applying power.

Risk of electric shock.

Residual voltages inside the Soloist controller may exceed 60 Volts after AC power has been disconnected for 10 seconds.

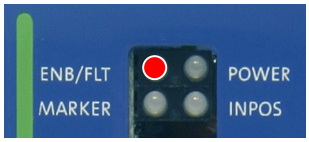


Table 6-1. Amplifier Faults, Causes, and Solutions

Symptom	Possible Cause and Solution
Motor rotates uncontrollably	Encoder (sine and cosine) signals are improperly connected. See Section 2.8. for motor phasing information.
Brushless motor will not rotate.	Motor phases A, B, and C connected incorrectly relative to Hall A, Hall B, and Hall C inputs. See Section 2.8. for motor phasing information.
Amplifier faults (□ENB□ LED turns red) when motor decelerates.	Bus over-voltage detected (Soloist10/20). This condition indicates an excessive bus supply regeneration condition. The Soloist10/20 requires that a shunt regulator option be mounted in the unit.
Amplifier Faults ("ENB" LED turns red).	1. RMS current exceeded - run at lower current. 2. Over temperature condition - Remove power and let the drive cool down, and/or provide better ventilation. 3. Defective on board power supply - Return for repair.

6.2. Soloist Test Points

The following test points are available internally to the Soloist, refer to Section 6.4. for their locations. All test points not shown are for Aerotech internal use only.

Table 6-2. Soloist Control Board Test Points

Test Point	Description
TP1	5 Volt supply
TP2	-12 Volt supply
TP3	+12 Volt supply
TP4	Common
TP5	3.3 Volt supply

Table 6-3. -IO Option Board Test Points

Test Point	Description
TP4	Common

6.3. Fuse Replacement

Table 6-4 lists the manufacturer and Aerotech's part number for typical replacement fuses. Additional fuse information can be found on the system drawing supplied with the unit. See Section 6.4. for fuse location information.

Table 6-4. Soloist Fuse Information

Fuse	Description	Size	Aerotech P.N.	Manufacturer's P.N.
F1	Optional Shunt Fuse	2A S.B. (5 mm)	EIF01019	LittleFuse 215002
F2	Control Power Fuse	.25A S.B. (5 mm)	EIF1009	LittleFuse 230.250S
F4	**Soloist10** VAC Input at TB102-1	5A S.B (5 mm.)	EIF00179	Wickman 1951500
	Soloist20 VAC Input at TB102-1	10A S.B (5 mm.)	EIF01006	LittleFuse 218010
	Soloist30 VAC Input at TB102-1	10A S.B (5 mm.)	EIF01006	LittleFuse 218010

Always disconnect the mains power connection before opening the Soloist chassis.

Table 6-5. -IO Board Fuse Information

Fuse	Description	Size	Aerotech P.N.	Manufacturer's P.N.
F1	+5 VDC User Power	3A, resettable	EIF01001	RAYCHEM RGE300

6.4. Soloist Board Assembly

Figure 6-1 highlights the important components located on the control board. The Soloist has a few jumper selectable items, none of which normally need to be changed by the user, since all of the important configurable items are software selectable. Table 6-6 lists the jumpers and the default configurations for the Soloist board.

S1 defines the Soloist communication channel number and is the only user configured switch/jumper on the control board (see Table 2-3).

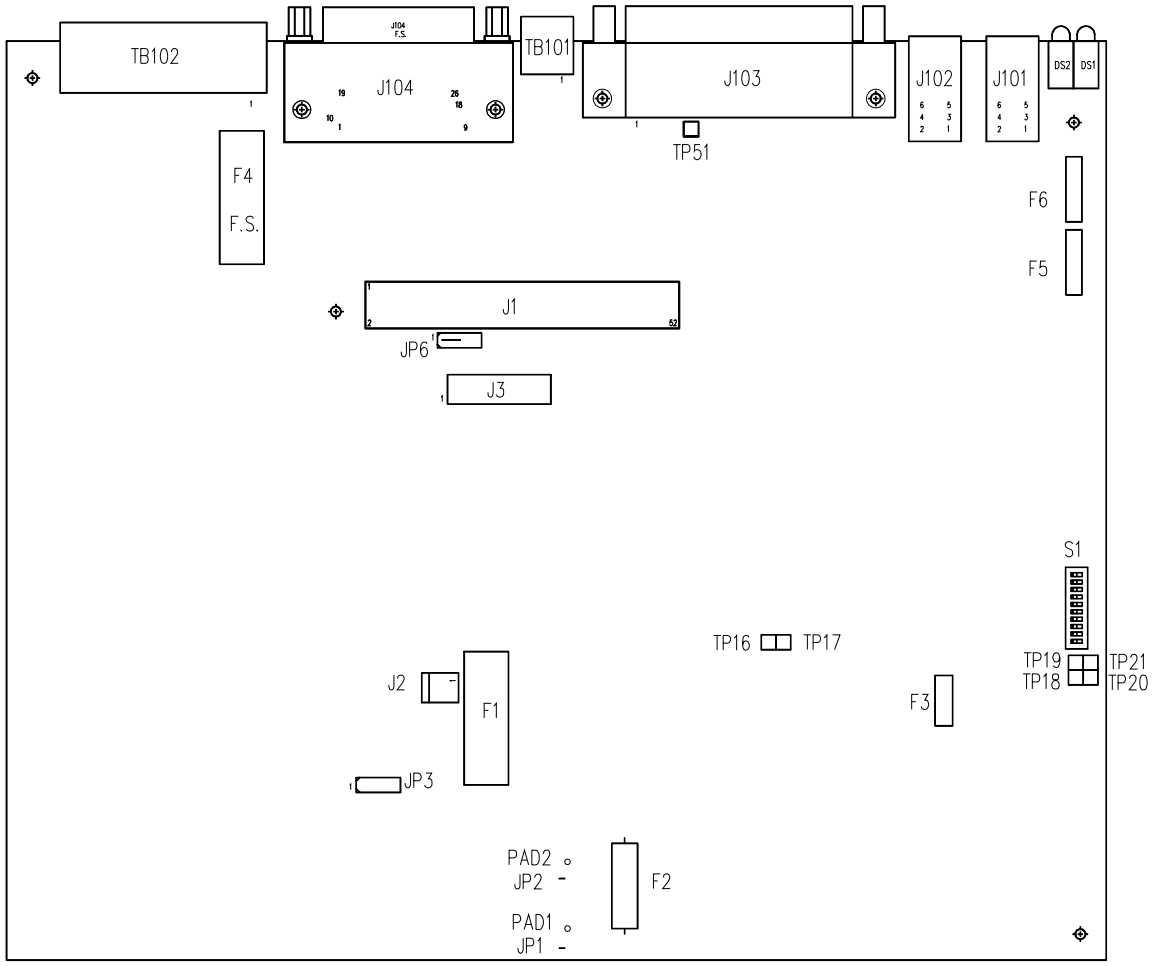


Figure 6-1. Soloist Board Assembly (690D1591 Rev. -)

Table 6-6. Soloist Jumper Selections

Jumpers	Positions	Function
JP3	1-2 *	No Shunt Option Present (Standard, Soloist10, 20)
	2-3	Shunt Option Present (Optional, except Soloist30)
JP5	1-2 *	Watch dog enabled (Standard)
	2-3	Watch dog disabled
JP6	1-2 *	24 Volt Emergency Stop (Standard)
	2-3	5 Volt Emergency Stop (-ESTOP05 option)

* Factory Default

All jumpers are factory-configured and should not be changed by the user.

See Table 6-4 for fuse replacement information.

6.5. Preventative Maintenance

The Soloist and external wiring should be inspected monthly. Inspections may be required at more frequent intervals, depending on the environment and use of the system. Table 6-7 lists the recommended checks that should be made during these inspections.

The Soloist (all Aerotech equipment) is not to be used in a manner not specified by Aerotech, Inc.

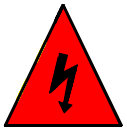
Table 6-7. Preventative Maintenance

Check	Action to be Taken
Visually Check chassis for loose or damaged parts / hardware. **Note**: Internal inspection is not required.	Parts should be repaired as required. If internal damage is suspected, these parts should be checked and repairs made if necessary.
Inspect cooling vents.	Remove any accumulated material from vents.
Check for fluids or electrically conductive material exposure.	Any fluids or electrically conductive material must not be permitted to enter the Soloist. **Note**: Disconnect power to avoid shock hazard.
Visually inspect all cables and connections.	Tighten or re-secure any loose connections. Replace worn or frayed cables. Replace broken connectors.

6.5.1. Cleaning

The Soloist chassis can be wiped with a clean, dry, soft cloth. The cloth may be slightly moistened if required with water or isopropyl alcohol to aid in cleaning if necessary. In this case, be careful not to allow moisture to enter the Soloist or onto exposed connectors/components. Fluids and sprays are not recommended because of the chance for internal contamination, which may result in electrical shorts and/or corrosion. The electrical power must be disconnected from the Soloist while cleaning. Do not allow cleaning substances or other fluids to enter the Soloist or to get on to any of the connectors. Cleaning labels should be avoided to prevent erasing label information.

Disconnect power to the Soloist main supply and optional supply before cleaning.



APPENDIX A: GLOSSARY OF TERMS

In This Section:

- Glossary A-1

Abbe Error — The positioning error resulting from angular motion and an offset between the measuring device and the point of interest.

Abbe Offset — The value of the offset between the measuring device and the point of interest.

Absolute Move — A move referenced to a known point or datum.

Absolute Programming — A positioning coordinate reference where all positions are specified relative to a reference or "home" position.

AC Brushless Servo — A servomotor with stationary windings in the stator assembly and permanent magnet rotor. AC brushless generally refers to a sinusoidally wound motor (such as BM series) to be commutated via sinusoidal current waveform (see DC brushless servo).

Acceleration — The change in velocity as a function of time.

Accuracy — An absolute measurement defining the difference between actual and commanded position.

Accuracy Grade — In reference to an encoder grating, accuracy grade is the tolerance of the placement of the graduations on the encoder scale.

ASCII — American Standard Code for Information Interchange. This code assigns a number to each numeral and letter of the alphabet. Information can then be transmitted between machines as a series of binary numbers.

Axial Runout — Positioning error of the rotary stage in the vertical direction when the tabletop is oriented in the horizontal plane. Axial runout is defined as the total indicator reading on a spherical ball positioned 50 mm above the tabletop and centered on the axis of rotation.

Axis of Rotation — A center line about which rotation occurs.

Back emf, Kemf — The voltage generated when a permanent magnet motor is rotated. This voltage is proportional to motor speed and is present whether or not the motor windings are energized.

Backlash — A component of bidirectional repeatability, it is the non-responsiveness of the system load to reversal of input command.

Ball Screw	A precision device for translating rotary motion into linear motion. A lead screw is a low-cost lower performance device performing the same function. Unit consists of an externally threaded screw and an internally threaded ball nut.
Ball Screw Lead	The linear distance a carriage will travel for one revolution of the ball screw (lead screw).
Bandwidth	A measurement, expressed in frequency (hertz), of the range which an amplifier or motor can respond to an input command from DC to -3dB on a frequency sweep.
Baud Rate	The number of bits transmitted per second on a serial communication channel such as RS-232 or modem.
BCD	Binary Coded Decimal - A number system using four bits to represent 0-F (15).
Bearing	A support mechanism allowing relative motion between two surfaces loaded against each other. This can be a rotary ball bearing, linear slide bearing, or air bearing (zero friction).
Bidirectional Repeatability	See Repeatability.
CAM Profile	A technique used to perform nonlinear motion that is electronically similar to the motion achieved with mechanical cams.
Cantilevered Load	A load not symmetrically mounted on a stage.
Closed Loop	A broad term relating to any system where the output is measured and compared to the input. Output is adjusted to reach the desired condition.
CNC	Computer Numerical Control. A computer-based motion control device programmable in numerical word address format.
Coefficient of Friction	Defined as the ratio of the force required to move a given load to the magnitude of that load.
Cogging	Nonuniform angular/linear velocity. Cogging appears as a jerkiness, especially at low speeds, and is due to magnetic poles attracting to steel laminations.
Commutation	The action of steering currents to the proper motor phases to produce optimum motor torque/force. In brush-type motors, commutation is done electromechanically via the brushes and commutator. A brushless motor is electronically commutated using a position feedback device such as an encoder or Hall effect devices. Stepping motors are electronically commutated without feedback in an open-loop fashion.

Commutation, 6-Step	Also referred to as trapezoidal commutation. The process of switching motor phase current based on three Hall effect signals spaced 120 electrical degrees beginning 30 degrees into the electrical cycle. This method is the easiest for commutation of brushless motors.
Commutation, Modified 6-Step	Also referred to as modified sine commutation. The process of switching motor phase current based on three Hall effect signals spaced 120 electrical degrees beginning at 0 electrical degrees. This method is slightly more difficult to implement than standard 6-step, but more closely approximates the motor's back emf. The result is smoother control and less ripple. Aerotech's BA series self-commutate using this method.
Commutation, Sinusoidal	The process of switching motor phase current based on motor position information, usually from an encoder. In this method, the three phase currents are switched in very small increments that closely resemble the motor's back emf. Sinusoidal commutation requires digital signal processing to convert position information into three-phase current values and, consequently, is most expensive to implement. The result, however, is the best possible control. All Aerotech controllers, as well as the BAS series amplifiers, commutate using this method.
Coordinated Motion	Multi-axis motion where the position of each axis is dependent on the other axis, such that the path and velocity of a move can be accurately controlled. Drawing a circle requires coordinated motion.
Critical Speed	A term used in the specification of a lead screw or ball screw indicating the maximum rotation speed before resonance occurs. This speed limit is a function of the screw diameter, distance between support bearings, and bearing rigidity.
Current Command	Motor driver or amplifier configuration where the input signal is commanding motor current directly, which translates to motor torque/force at the motor output. Brushless motors can be commutated directly from a controller that can output current phase A and B commands.
Current, Peak	An allowable current to run a motor above its rated load, usually during starting conditions. Peak current listed on a data sheet is usually the highest current safely allowed to the motor.
Current, rms	Root Mean Square. Average of effective currents over an amount of time. This current is calculated based on the load and duty cycle of the application.

Cycle	When motion is repeated (move and dwell) such as repetitive back-and-forth motion.
DC Brushless Servo	A servomotor with stationary windings in the stator assembly and permanent magnet rotor. (See AC Brushless Servo)
Deceleration	The change in velocity as a function of time.
Duty Cycle	For a repetitive cycle, the ratio of "on" time to total cycle time used to determine a motor's rms current and torque/force.
Dwell Time	Time in a cycle at which no motion occurs. Used in the calculation of rms power.
Efficiency	Ratio of input power vs. output power.
Electronic Gearing	Technique used to electrically simulate mechanical gearing. Causes one closed loop axis to be slaved to another open or closed loop axis with a variable ratio.
Encoder Marker	Once-per-revolution signal provided by some incremental encoders to accurately specify a reference point within that revolution. Also known as Zero Reference Signal or Index Pulse.
Encoder Resolution	Measure of the smallest positional change which can be detected by the encoder. A 1000-line encoder with a quadrature output will produce 4000 counts per revolution.
Encoder, Incremental	Position encoding device in which the output is a series of pulses relative to the amount of movement.
Feedback	Signal that provides process or loop information such as speed, torque, and position back to the controller to produce a "closed loop" system.
Flatness (of travel)	Measure of the vertical deviation of a stage as it travels in a horizontal plane.
Force, Continuous	The value of force that a particular motor can produce in a continuous stall or running (as calculated by the rms values) condition.
Force, Peak	The maximum value of force that a particular motor can produce. When sizing for a specific application, the peak force is usually that required during acceleration and deceleration of the move profile. The peak force is used in conjunction with the continuous force and duty cycle to calculate the rms force required by the application.
Friction	The resistance to motion between two surfaces in contact with each other.

G.P.I.B.	A standard protocol, analogous to RS-232, for transmitting digital information. The G.P.I.B. interface (IEEE-488) transmits data in parallel instead of serial format. (See IEEE-488)
Gain	Comparison or ratio of the output signal and the input signal. In general, the higher the system gain, the higher the response.
Grating Period	Actual distance between graduations on an encoder.
Hall Effect Sensors	Feedback device (HED) used in a brushless servo system to provide information for the amplifier to electronically commutate the motor.
HED	Hall Effect Device. (See Hall Effect Sensors)
HMI	Human Machine Interface. Used as a means of getting operator data into the system. (See MMI)
Home	Reference position for all absolute positioning movements. Usually defined by a home limit switch and/or encoder marker.
Home Switch	A sensor used to determine an accurate starting position for the home cycle.
Hysteresis	A component of bidirectional repeatability. Hysteresis is the deviation between actual and commanded position and is created by the elastic forces in the drive systems.
I/O	Input / Output. The reception and transmission of information between control devices using discrete connection points.
IEEE-488	A set of codes and formats to be used by devices connected via a parallel bus system. This standard also defines communication protocols that are necessary for message exchanges, and further defines common commands and characteristics. (See G.P.I.B.)
Incremental Move	A move referenced from its starting point (relative move).
Inertia	The physical property of an object to resist changes in velocity when acted upon by an outside force. Inertia is dependent upon the mass and shape of an object.
Lead Error	The deviation of a lead screw or ball screw from its nominal pitch.
Lead Screw	A device for translating rotary motion into linear motion. Unit consists of an externally threaded screw and an internally threaded carriage (nut). (See Ball Screw)

Life	The minimum rated lifetime of a stage at maximum payload while maintaining positioning specifications.
Limit Switch	A sensor used to determine the end of travel on a linear motion assembly.
Limits	Sensors called limits that alert the control electronics that the physical end of travel is being approached and motion should stop.
Linear Motor	A motor consisting of 2 parts, typically a moving coil and stationary magnet track. When driven with a standard servo amplifier, it creates a thrust force along the longitudinal axis of the magnet track.
Load Carrying Capability	The maximum recommended payload that does not degrade the listed specifications for a mechanical stage.
Master-Slave	Type of coordinated motion control where the master axis position is used to generate one or more slave axis position commands.
MMI	Man Machine Interface used as a means of getting operator data into the system. (See HMI)
Motion Profile	A method of describing a process in terms of velocity, time, and position.
Motor Brush	The conductive element in a DC brush-type motor used to transfer current to the internal windings.
Motor, Brushless	Type of direct current motor that utilizes electronic commutation rather than brushes to transfer current.
Motor, Stepping	Specialized motor that allows discrete positioning without feedback. Used for noncritical, low power applications, since positional information is easily lost if acceleration or velocity limits are exceeded.
NC	Numerical Control. Automated equipment or process used for contouring or positioning. (See CNC)
NEMA	National Electrical Manufacturer's Association. Sets standards for motors and other industrial electrical equipment.
Non-Volatile Memory	Memory in a system that maintains information when power is removed.
Open Collector	A signal output that is performed with a transistor. Open collector output acts like a switch closure with one end of the switch at circuit common potential and the other end of the switch accessible.
Open Loop	Control circuit that has an input signal only, and thus cannot make any corrections based on external influences.

Operator Interface	Device that allows the operator to communicate with a machine. A keyboard or thumbwheel is used to enter instructions into a machine. (See HMI or MMI)
Optical Encoder	A linear or angular position feedback device using light fringes to develop position information.
Opto-isolated	System or circuit that transmits signal with no direct electrical connections, using photoelectric coupling between elements.
Orthogonality	The condition of a surface or axis which is perpendicular (offset 90 degrees) to a second surface or axis. Orthogonality specification refers to the error from 90 degrees from which two surfaces of axes are aligned.
Overshoot	In a servo system, referred to the amount of velocity and/or position overrun from the input command. Overshoot is a result of many factors including mechanical structure, tuning gains, servo controller capability, and inertial mismatch.
PID	A group of gain terms in classical control theory (Proportional Integral Derivative) used in compensation of a closed-loop system. The terms are optimally adjusted to have the output response equal the input command. Aerotech controllers utilize the more sophisticated PID FVFA loop which incorporates additional terms for greater system performance.
Pitch (of travel)	Angular motion of a carriage around an axis perpendicular to the motion direction and perpendicular to the yaw axis.
Pitch Error	Positioning error resulting from a pitching motion.
PLC	Programmable Logic Controller. A programmable device that utilizes "ladder logic" to control a number of input and output discrete devices.
PWM	Pulse Width Modulation. Switch-mode technique used in amplifiers and drivers to control motor current. The output voltage is constant and switched at the bus value (160 VDC with a 115 VAC input line).
Quadrature	Refers to the property of position transducers that allows them to detect direction of motion using the phase relationship of two signal channels. A 1000-line encoder will yield 4000 counts via quadrature.
Radial Runout	Positioning error of the rotary stage in the horizontal direction when the tabletop is oriented in the horizontal plane. Radial runout is defined as the total indicator reading on a spherical ball positioned 50 mm above the tabletop and centered on the axis of rotation.
Ramp Time	Time it takes to accelerate from one velocity to another.

Range	The maximum allowable travel of a positioning stage.
RDC	Resolver to Digital Converter. Electronic component that converts the analog signals from a resolver (transmitter type) into a digital word representing angular position.
Repeatability	The maximum deviation from the mean (each side) when repeatedly approaching a position. Unidirectional repeatability refers to the value established by moving toward a position in the same direction. Bidirectional repeatability refers to the value established by moving toward a position in the same or opposite direction.
Resolution	The smallest change in distance that a device can measure.
Retroreflector	An optical element with the property that an input light beam is reflected and returns along the same angle as the input beam. Used with laser interferometers.
Roll (of travel)	Angular motion of a carriage around an axis parallel to the motion direction and perpendicular to the yaw axis.
Roll Error	Positioning error resulting from a roll motion.
Rotor	The rotating part of a magnetic structure. In a motor, the rotor is connected to the motor shaft.
RS-232C	Industry standard for sending signals utilizing a single-ended driver/receiver circuit. As such, the maximum distance is limited based on the baud rate setting but is typically 50-100 feet. This standard defines pin assignments, handshaking, and signal levels for receiving and sending devices.
RS-274	Industry standard programming language. Also referred to as G-code machine programming. A command set specific for the machine tool industry that defines geometric moves.
RS-422	Industry communication standard for sending signals over distances up to 4000 feet. Standard line driver encoder interfaces utilize RS-422 because of the noise immunity.
Runout	The deviation from the desired form of a surface during full rotation (360 degrees) about an axis. Runout is measured as total indicated reading (TIR). For a rotary stage, axis runout refers to the deviation of the axis of rotation from the theoretical axis of rotation.
Servo System	Refers to a closed loop control system where a command is issued for a change in position and the change is then verified via a feedback system.

Settling Time	Time required for a motion system to cease motion once the command for motion has ended.
Shaft Radial Load	Maximum radial load that can be applied to the end of the motor shaft at maximum motor speed.
Shaft Runout	Deviation from straight line travel.
Slotless	Describes the type of laminations used in a motor that eliminates cogging torque due to magnetic attraction of the rotor to the stator slots.
Stator	Non-rotating part of a magnetic structure. In a motor, the stator usually contains the mounting surface, bearings, and non-rotating windings.
Stiction	Friction encountered when accelerating an object from a stationary position. Static friction is always greater than moving friction, and limits the smallest possible increment of movement.
Straightness of Travel	Measure of the side-to-side deviation of a stage as it travels in a horizontal plane.
Torque	Rotary equivalent to force. Equal to the product of the force perpendicular to the radius of motion and distance from the center of rotation to the point where the force is applied.
Torque, Continuous	Torque needed to drive a load over a continuous time.
Torque, Peak	Maximum amount of torque a motor can deliver when the highest allowable peak currents are applied.
Torque, rms	Root Mean Square is a mathematical method to determine a steadfast or average torque for a motor.
Torque, Stall	The maximum torque without burning out the motor.
Total Indicated Reading (TIR)	The full indicator reading observed when a dial indicator is in contact with the part surface during one full revolution of the part about its axis of rotation.
Tuning	In a servo system, the process of optimizing loop gains (usually PID terms) to achieve the desired response from a stage or mechanism from an input command.
Unidirectional Repeatability	See Repeatability
Velocity Command	Motor driver or amplifier configuration where the input signal is commanding motor velocity. Motors with analog tachometers are normally driven by this driver configuration.

Wobble	An irregular, non-repeatable rocking or staggering motion of the table top of a rotary stage. Wobble is defined as an angular error between the actual axis of rotation and the theoretical axis of rotation.
Yaw (of travel)	Rotation about the vertical axis, perpendicular to the axis of travel. Angular movement (error) that affects straightness and positioning accuracy.
Yaw Error	Positioning error resulting from a yaw motion.

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APPENDIX B: WARRANTY AND FIELD SERVICE

In This Section:

- Laser Products B-1
- Return Procedure B-1
- Returned Product Warranty Determination..... B-2
- Returned Product Non-warranty Determination B-2
- Rush Service B-2
- On-site Warranty Repair B-2
- On-site Non-warranty Repair B-2

Aerotech, Inc. warrants its products to be free from defects caused by faulty materials or poor workmanship for a minimum period of one year from date of shipment from Aerotech. Aerotech's liability is limited to replacing, repairing or issuing credit, at its option, for any products that are returned by the original purchaser during the warranty period. Aerotech makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, where or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability or any claim for loss or damage arising out of the sale, resale or use of any of its products shall in no event exceed the selling price of the unit.

Laser Products

Aerotech, Inc. warrants its laser products to the original purchaser for a minimum period of one year from date of shipment. This warranty covers defects in workmanship and material and is voided for all laser power supplies, plasma tubes and laser systems subject to electrical or physical abuse, tampering (such as opening the housing or removal of the serial tag) or improper operation as determined by Aerotech. This warranty is also voided for failure to comply with Aerotech's return procedures.

Return Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within (30) days of shipment of incorrect materials. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. Any returned product(s) must be accompanied by a return authorization number. The return authorization number may be obtained by calling an Aerotech service center. Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than (30) days after the issuance of a return authorization number will be subject to review.

Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warranted defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an air freight return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

Returned Product Non-warranty Determination

After Aerotech's examination, the buyer shall be notified of the repair cost. At such time, the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within (30) days of notification will result in the product(s) being returned as is, at the buyer's expense. Repair work is warranted for (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

On-site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty-related, then the following policy applies:

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special service rates apply.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following "On-Site Non-Warranty Repair" section apply.

On-site Non-warranty Repair

If any Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies:

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.

Company Address

Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238-2897
USA

Phone: (412) 963-7470
Fax: (412) 963-7459

APPENDIX C: TECHNICAL CHANGES

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- Current Changes..... C-1
- Archive of Changes..... C-2

C.1. Current Changes

Table C-1. Current Changes

Version	Section(s) Affected	General Information
1.4	1.6.	Corrected Input and Output power Specifications in Table 1-2, in Section 1.6.
	2.6.	Added E-STOP noise suppression requirement note and Table 2-5.
	2.10	Added note to remove power before changing communication channel settings.
	3.1.1	Clarified PSO output text in paragraph 2 and updated Figure 3-1 to show interface to a single-ended device.
	3.1.3.	Corrected high-speed input voltage spec. from 5-24 to 5 volts only. Updated Figure 3-6, 3-7 to show 2 inputs connected.
	3.2.	Removed errant "Window array" reference in Figure 3-11.
	4.2.4	Fixed schematic/picture in Figure 4-6 and corrected text to indicate "these inputs are scaled for 5-24 volt logic". (High-speed inputs in Sec. 3.1.3 are 5 volt only.)
	6.3	Corrected fuse F4 for the Soloist30 to LittleFuse P.N. from 2184010 to 218010

C.2. Archive of Changes

Version	Section(s) Affected	General Information
1.0	All New	First release of the manual.
1.1	--	Formatting changes, non-technical.
1.2	Chap. 3, 4	Digital I/O renumbered from 0-n, to Port 0, 0-7, Port 1, 0-7 and Port 2, 0-7. Chap. 4 Picture updated.
1.3	3.3.2, 4.2.6	Relay always present, not just with -IO opt. and re-worded entire section, normally open, was incorrectly indicated as, normally closed

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P/N EDU180, April 2005

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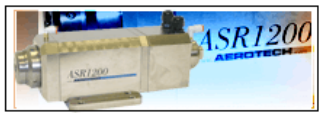
ASR1200 Rotary Stage

The ASR1200 series is an extension of the successful ASR1100 series direct-drive rotary stage. The ASR1200 includes the integral pneumatically operated collet chuck for automated material handling that is found on the ASR1100, but the ASR1200 also includes a sealed water jacket for wet cutting processes. The ASR1200 series utilizes Aerotech's direct-drive brushless motor technology to maximize positioning performance in 24/7 production environments.



Soloist Single Axis Servo Controller

Aerotech's Soloist™ is a single-axis servo controller that combines a power supply, amplifier, and position controller in a single package. The Soloist can control up to four tasks simultaneously, as well as handle variables and manage I/O, for demanding production applications. It has high-speed position latch inputs and advanced data logging capabilities that make it ideal for laboratory, test, and industrial applications.

NServo: Easy machine retrofits, preserve your capital investment

NServo provides an economical method to retrofit any existing system that uses analog servo amplifiers to the performance and flexibility of the Automation 3200 platform. NServo is a digital 2- or 4-axis, 20 kHz sample time servo (position and velocity) controller. NServo complements the Automation 3200 system's network digital drives (Ndrive®, NLdrive, NCdrive, and Npaq®), allowing industry standard analog amplifiers to interface to Aerotech's digital drive network.

ARA1000 Rotary Stage

The ARA1000 rotary actuator was designed for applications requiring articulation for large

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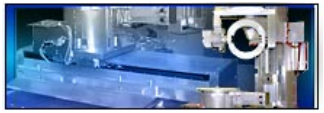
payloads. It eliminates the mechanical instability of high load inertia, multi-axis systems through a proprietary design that significantly increases stage stiffness.

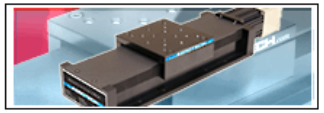
Engineered System

Aerotech has over 30 years of experience manufacturing turnkey and complete motion subsystems for some of the largest companies in the world. Our engineers and technicians have developed an array of systems for applications ranging from semiconductor, medical, laboratory, photonics and fiberoptics, laser machining, automotive, packaging, pick and place, and more. We are well-versed in vacuum and clean room techniques.



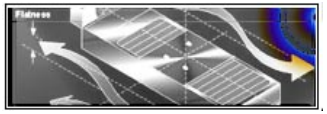
ATS125 Linear Stage

The ATS125 is Aerotech's smallest hard cover, side-sealed stage design. The brushless integral motor option further reduces the overall footprint of the stage enabling its deployment in space-constrained applications. The ATS125 provides low cost with high performance, providing travels up to 600 mm and speeds up to 600 mm/s.



Engineering Reference

Aerotech provides answers to common questions encountered when implementing motion control and positioning solutions, including: resolution, accuracy, and repeatability; linear stage terminology; rotary stage terminology; metrology, testing, and certification; cantilevered loading; loading versus lifetime; computing maximum data rate; motor sizing; and much more.



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